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Tuesday, September 18.	**Current Academic Year Began.**
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Thursday, November 29.	**Thanksgiving Day.**
Wednesday, December 5.	**Meeting of Scientific Association, 8 p. m.**
Friday, December 7.	**Meeting of Philological Association, 12. m.**
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rials purchased by loans. Every band of workers failed and Christian socialism came temporarily to a stand-still. Mr. Kingsley became discouraged and fell out of the ranks, but Mr. Neale, Mr. Hughes and others kept bravely on and allied themselves to the distributive coöperation of the north of England, which received a mighty impulse from the Rochdale Pioneers. This association and many others have formed themselves into a Union, a great organization which now embraces directly or indirectly four or five millions of Englishmen. It has thus become leavened by the notions of practical Christianity as taught by Maurice and his followers. The three principles as formulated by Maurice, are the following:

I. That human society is a brotherhood, not a collection of warring atoms;
II. That true workers should be fellow-workers, not rivals;
III. That a principle of justice not of selfishness should regulate exchanges.

It is in the ultimate and complete triumph of coöperation that Mr Hughes sees the salvation of England.

NOTE.—A considerable part of the material for the paper of which the above is an abstract, was kindly furnished the writer by Mr. Hughes in personal conversation during his recent visit in this country.

NOTES IN BIOLOGY.

Abstract of Observations on the Development of Balanoglossus, by WILLIAM BATESON, Cambridge, England.

[Note from the Chesapeake Zoölogical Laboratory, 1883].

An unlimited quantity of this remarkable form was easily to be obtained at half-tide all along the shores in the neighborhood of Hampton, Virginia. The difficulties attending the investigation were far less than those that have been previously met with at other localities. Since the time during which I have been able to remain in America was exceedingly limited, I thought it best to confine my work at Hampton to the study of fresh specimens of the animal, and to the task of collecting and preserving them for subsequent examinations by means of sections. My observations are, therefore, very meagre and inadequate, especially as regards the organogeny of the form, owing to the extreme scarcity of the larva. These important deficiencies I hope subsequently to supply when I shall have been able to examine my material by sectional methods. The general appearance of the Hampton form presents many points of slight divergence from the species common at Naples (*B. minutus*), so that at first sight the two animals seem very different, but whether the anatomy of this form is essentially different, I could not decide by examination of fresh specimens alone. The principal result of my work has been to show that the form common on the Chesapeake coast does not pass through the Tornaria stage, which has been described by previous observers as the larva of Balanoglossus. The eggs of this animal are opaque, yellowish grey bodies, inclosed in a thin tough egg-shell which is quite transparent. Segmentation is begun by the appearance of a median furrow which divides the egg into two equal halves. This is followed by another median furrow at right angles to the first, forming four segments. In the next stage that I have been able to observe segmentation was complete, having probably proceeded in a regular manner, though of this I have not been able to determine. One edge of this blastospore is next flattened and gradually depressed, causing the embryo to take the shape of a concavo-convex disk. The concavity becomes gradually reduced in size as its edges grow together to form the blastospore, appearing at the same time to become thickened. This process is continued until the blastospore becomes exceedingly small; whether it subsequently disappears or not I cannot say until I have cut sections of it. I believe, however, that it becomes the anus, which at all events is found in the same position. As this gastrula becomes shut off it resumes the spherical shape and begins to rotate about the axis, which eventually becomes the long axis of the animal, at the top of which the blastospore is placed. This rotary movement is caused by a uniform covering of fine cilia. After rotating in this way for some few hours, the body elongates and a ring of large cilia appears surrounding the posterior end. The animal then swims round the egg, rotating at the same time on its long axis. A nearly median transverse constriction next occurs, which is followed by another one anterior to it, giving the body the appearance of being composed of three segments. The anterior segments become the proboscis, the middle one forms the collar, and from the posterior portion the rest of the body is developed. Within the anterior constriction the mouth is subsequently formed. At the anterior end of the proboscis a tuft of fine long cilia grows out as in the larvæ of many Chœbopoda, etc. A pair of depressions are at the same time formed posteriorly to the collar in a dorsal position. These depressions form the first pair of gill slits. In this condition the larva is generally hatched, though I have found individuals already free before the appearance of the transverse constriction. On hatching these larvæ are still quite opaque, and live buried in the muddy sand which the adults inhabit. In this condition the animal remains for some time, increasing in size, until it is about an eighth of an inch long, the proboscis being about half the total length of the body. The tip of the proboscis is used by the larvæ to attach themselves by suction to foreign bodies, though apparently no special suctorial organ exists. As the body grows, the posterior band of cilia becomes wider and the cilia themselves longer and coarser while the direction of the band alters slightly. From the appearance o fresh specimens in this stage, treated with acetic acid, I believe that severa pouches arise from the gut which probably are destined to form the other gill slits, but this is quite uncertain, though of course sections wil at once decide this question. I have been unable to procure any specimens older than these, and of the changes by which this larva becomes converted into Balanoglossus, I can therefore say nothing. Possibly the animal remains in this condition during the winter and awaits the spring for its final developments. I hope to be able to observe the subsequent stages at some future season.

On the Osteology and Development of Syngnathus Peckeanus (Storer), by J. PLAYFAIR MCMURRICH, M. A., Guelph, Ontario.

(This paper is an abstract of observations which were made during the past winter upon embryos obtained at Beaufort during the preceding summer).

The embryonic cranium is characterized by its relative shortness as compared with the adult, a character due to the bending up at their extremities of the coalesced Trabeculæ Cranii. As development proceeds this bending up does not diminish, but the mouth is carried forward by a growth of the horizontal portion of the trabeculæ and it is not until a comparatively late stage that the elongation of the snout is dependent upon the straightening out of the rostral cartilage. In the adult the occipital region extends comparatively far forwards while the proötic region is exceedingly compact. Basi-, ali-, and orbito-sphenoids are wanting, so that the canal for the passage of the orbital muscles is exceedingly large. There are no nasals, and the parietals are small and merit the term "dermo-epiotics."

With regard to the suspensorial, hyoid and branchial apparatus, the symplectic is very long, and as a consequence there is a separation of the hyomandibular and metapterygoid elements. The ethmo-palatine cartilage is at first quite separate from the pterygoid process of pterygo-quadrate but finally unites with it. Mr. J. A. Ryder has described these cartilages in Hippocampus as the intermaxillary and maxillary cartilages respectively, a nomenclature, which from our knowledge of the development of these parts, and as I have satisfied myself by tracing the subsequent history of the cartilages, is incorrect. In the adult the great elongation backwards of the metapterygoid and quadrate bones, the abortion of the genio-hyoid which is well marked in embryonic stages and the absence of intermaxillaries are traceable points. The branchial arches are never more than four and are exceedingly simple in structure.

The dermal scales appear as stout membranous plates in which ossification takes place concomitantly with that of the neural and transverse processes of the vertebræ, as a result of which the scales become supported by or sit astride of the vetebral processes, thus giving firm protection to the structures within and replacing the ribs. During embryonic life an anal fin is present, which however does not develop completely and disappears entirely in the adult.

The gills are in reality not tufted but their appearance is due to the leaflets, of which there are four rows to each rachis, gradually increasing in size from below upwards until near the extremity when they suddenly decrease. The degeneration of the arches and the peculiar arrangement of the leaflets I imagine to be due to the almost complete closing in of the gill-cavity, which is evidently an old ancestral character, since even in the youngest stages the branchial-cavity was completely closed by a membrane. No communication exists between the intestine and the yolk-sack, and a valve is early formed by a constriction of the walls of intestine, which separates the rectum from the intestine proper.

An Instance of Sexual Color Variation in Crustacea, by H. W. CONN.

[Note from the Chesapeake Zoölogical Laboratory, 1883].

Differences in the color of the two sexes among Crustacea are of very rare occurrence. Darwin in *The Descent of Man*, chap. ix, refers to this fact and says he is acquainted with but two instances of this peculiarity. One in the case of Squilla stylifera, and a second in a species of Gelasmus, or fiddler crab, described by Fritz Müller as occurring in Brazil. A third and very striking instance is found in Callinectes (Neptunus) hastata, the common edible crab of our southern coast. There are a number of differences in the shape of the two sexes, but besides these they present a marked difference in color. This color variation is confined to the first pair of thoracic appendages, the pair bearing the large chelae. These appendages are of a yellowish brown on the upper surface, a whitish yellow on the outside and of a brilliant blue on the inside and particularly at those parts which are protected from the light when the appendage is folded. It would seem therefore that this blue coloration was enhanced by not being exposed to light. The color of different individuals is tolerably constant and uniform.

Between the colors of the male and female appendage considerable differences are discernable. The most noticeable difference is that the male appendage appears remarkably blue when compared with the female. This is due partly to the fact that the amount of blue surface in the male is much greater than in the female, and partly to the fact that the blue color is of a much more brilliant hue. The blue color in the male extends nearly to the tips of the two fingers of the chelae, both the finger-like process of the propodite and the dactylopodite being largely colored blue. The very tips are, however, of a brilliant purple. In the female these parts are of an orange hue with not a trace of blue about them. Its tips are also colored purple but not so brilliant a purple as is found in the male. In the male the blue color extends partly upon the outer surface. In the female it is confined to the inner surface and only extends to the base of the dactylopodite. The outer surface of the dactylopodite and of the finger-like process of the propodite are in the male white, while in the female they are reddish orange. Upon the male appendage there is no orange color as a rule.

These differences in color are in all cases very marked, and will always serve to distinguish a male from a female appendage. No color differences are seen in any part of the crab except upon the first pair of appendages, and it is interesting to note that this sexual difference does not make its appearance till the crab reaches maturity. The chelae of immature males and females cannot be distinguished from each other. Fritz Müller says that the same is true of the Gelasmus species observed by him. On the other hand, considering the habits of Crustacea, these sexual differences can hardly be considered as the results of sexual selection.

Experiments upon the Heart of the Dog with reference to the Maximum Volume of Blood sent out by the Left Ventricle in a Single Beat, and the Influence of Variations in Venous Pressure, Arterial Pressure, and Pulse Rate upon the Work done by the Heart, by W. H. HOWELL *and* F. DONALDSON, JR.

[Abstract reprinted from the Proceedings of the Royal Society of London, No. 226, 1883].

Owing to the indirectness of the methods hitherto used for estimating the quantity of blood pumped out from the left ventricle at each systole, this important factor in all calculations of the work done by the heart has never been satisfactorily determined. Volkmann, and afterwards Vierordt, from calculations based upon the mean velocity of the stream of blood in the unbranched aorta, obtained the fraction $\frac{1}{400}$ as representing the ratio between the weight of blood thrown out at each systole and the body-weight. Fick, from data obtained by placing the arm in a plethysmograph, arrived at a much smaller fraction, $\frac{1}{1000}$. In our investigation we have made use of the dog's heart, completely isolated from all other organs of the body, with the exception of the lungs, after the method devised by Professor Martin. By this method it is possible to estimate directly the quantity of blood ejected from the left ventricle at each systole.

With regard to the maximum quantity of blood which can be thrown out from the left ventricle at a single systole, the general result of the experiments may be stated as follows: With a mean pulse rate of 180 per minute, the mean ratio of the maximum weight of blood pumped out from the left ventricle at each systole to the body weight is $\frac{1}{585}$ or .0017. In one experiment in which the pulse rate was 120 per minute, about the normal rate, the ratio obtained was $\frac{1}{700}$ or .0014. In applying these results to the normal dog, we believe that the average quantity of blood pumped out from the left ventricle at each systole in the living dog, is approximated most closely in the experiments given by the maximum outflow obtained from the isolated heart.

Variations of arterial pressure, from 58 to 147 millims. of mercury, were found to have no direct effect whatever upon the quantity of blood sent out from the left ventricle at each systole. Since the pulse rate is not altered, the work done by the left ventricle varies directly as the arterial pressure against which it works, within the limits named. For how much wider limits than those given this may hold true was not determined. There is every reason to believe that under normal conditions the force of the systole is more than sufficient to completely empty the ventricular cavity, and since, with arterial pressures from 58 to 147 millims., the quantity of blood ejected at each systole remains constant, it seems probable that within these limits, at least, the force of the ventricular contraction is not influenced by variations in arterial pressure, but remains maximal throughout.

Variations of venous pressure on the right side of the heart influence in a marked manner the outflow from the left ventricle. As the general result of the experiments it was found that the outflow from the left ventricle, and consequently the work done by it, increases with the venous pressure, but not proportionally, up to the point of maximum work.

Variations in the rate of beat of the heart were obtained by heating or cooling the blood supplied to it. The general result may be stated as follows: A diminution of pulse rate, brought about by lowering the temperature of the blood flowing into the heart, causes an increase in the quantity of blood thrown out from the ventricle at each systole, and consequently an increase in the work done at each systole, and vice versâ. The changes in the outflow from the ventricle at each systole are not, however, inversely proportional to the changes in the pulse rate. The total outflow, and, therefore, the total work done during any given period of time, decreases with a diminished pulse rate, and increases with an increased pulse rate.

NOTES IN PHILOLOGY.

On the Exemplar of Cod. C in the Apocalypse, by J. R. HARRIS.

[Abstract of a paper read before the University Philological Association, October 5, 1883].

In the Introduction to Westcott's and Hort's New Testament, the following remarks are made:

"The transition from small portable MSS. of limited contents is strikingly illustrated by a fortunate accident in the transcription of one of the four great comprehensive MSS. which are the earliest now extant. In the MS. of the Apocalypse from which C was taken some leaves had been displaced, and the scribe of C did not discover the displacement. It thus becomes easy to compute that each leaf of the exemplar contained only about as much as ten lines of the present edition; so that this one book must have made up nearly 120 small leaves of parchment, and accordingly formed a volume to itself or without considerable additions."

I propose to see how far the above suggestions will enable us to transfer the text of C into the pages of the exemplar.

The manuscript of C runs on smoothly enough to the end of the eighth page, (pages 5 and 6 being lost), after which another leaf is absent containing pages 9 and 10. Both of these lost leaves seem to correspond in compass with the omitted text. Page 11 then follows, and after some lines of page 12, we are abruptly carried back from c. x. 10 to c. vii. 17 so that the text runs as follows:

καὶ ἦν ἐν τῷ στόματί
μου ὡς μέλι γλυκύ . καὶ ὅτε ἐ δάκρυον ἐκ τῶν ὀφθαλ
μῶν αὐτῶν κτέ

The scribe continues on the new strain until the close of viii. 4: when he returns as abruptly as he departed; but not, be it observed, to the place he left, but to c. xi. 8, more advanced by about 10 lines of Westcott and Hort's text, so that the manuscript runs

ἐκ χειρὸς τοῦ ἀγγέλου ἐνώπιον τοῦ θεοῦ χιλίας
διακοσίας ἑξήκοντα

After this the text runs on smoothly, with the loss of certain of its leaves to the end of the book.

Evidently the passage inserted and the passage omitted are each of them pages of the exemplar. Moreover, since the lost leaves in which the transposed passage vii. 17–viii. 4. ought to have been found, correspond in compass to the missing text, it is evident that the two leaves of the exemplar with which we are concerned have been transposed.

Now with regard to the size of these leaves, let us employ as our measuring line, for convenience, a sixteen-syllabled hexameter, and let the text have the abbreviations that commonly belong to the words *θεὸς ἰησοῦς χριστὸς κύριος πνεῦμα* and *οὐρανός*. The two leaves of the exemplar will then be found to be 11 and 10.5 verses respectively.

If the writing had been perfectly even we should be able at once to form the roll of the exemplar by the process of subdivision; for from i. 1 to vii. 17 is evidently an exact number of pages, and from viii. 4 to x. 10 is also an exact number of pages. But the pages not being perfectly uniform, we must adopt the method of averages.

We have, then, from i. 1 to vii. 17 by actual measure 878.5 verses, and from viii. 4 to x. 10 we have 134.3 verses; and if the average page be just over 11 verses, this would give 88 pages up to the first transposed leaves and 12 pages between the two variable leaves. The total would, upon the same supposition be 1213.3 verses, or about 110 complete pages.

Now there is a very curious piece of transcriptional evidence which seems to show that not only C, but the first four or five verses of the Sinaitic codex were copied in the Apocalypse from a roll of this character.

For Tischendorf notes that the first few verses of the book down to *καὶ ἀπὸ ιῦ χῦ* in c. i. 5 were copied by a different scribe to the rest of the book, the same scribe. viz., who wrote six other conjugate leaves in the New Testament. The evidence for this statement consists in peculiar forms of the letters and in the use of the apostrophus at the close of lines.

Assuming, as I think we may, the accuracy of Tischendorf's judgment, we can hardly avoid the conclusion that the portion of the book copied by the scribe was a single page of the exemplar, since he stops in the very midst of a sentence in the text, and at an irregular point in his own column.

Examination of the portion of the text in question shows it to be 11.3 verses, or almost exactly the same as we were led to adopt as the average page in Codex C. It seems, therefore, that both these copies are derived from similarly written exemplars, and I think we may say that towards the restoration of this exemplar we have the 1st, 34th and 47th pages accurately defined, and the remaining pages to a close degree of approximation.

I see no reason to assume that this was a parchment book; it has every appearance of being an ordinary paper-roll.

I can see nothing in the text to account for the transposition of the two pages.

The reconstructed roll may perhaps, by the study of its parallel columns, help to explain some of the many curious variants in the text of the Apocalypse.

On Certain Irregular Vedic Subjunctives or Imperatives, by MAURICE BLOOMFIELD.

[Abstract of a paper read before the University Philological Association, October 5, 1883].

The Vedic forms referred to are those of the types *stota*, *guhóta*, *kṛṇóta*; *étana*; *kárta*, *íyarta*; *gánta*; *dádāta*; *unátta* — appearing at first sight to be so-called 'improper subjunctives,' but having irregularly strong stem-forms with accent on the stem, instead of on the ending. No real attempt has been previously made to explain them.

In looking over the subjunctives with mode-sign *a*, and secondary endings, we shall be struck by the fact, that the 2d and 3d dual and especially the 2d plural, are entirely unrepresented. The exclusion of so important a case as the 2d plural from an otherwise well-developed category is *a priori* improbable. It is very probable that just here must be sheltered such forms as *punàta* and *dádāta*, which are in all respects regular subjunctives, save that their ending is secondary. And this furnishes the key for the others also.

If we look over the subjunctive forms possible from a stem *çṛṇu*, for example, we find *çṛṇutá*, *çṛṇávatha* and **çṛṇávata*, it is seen at once why an additional form was needed: none of these, being of three or four light syllables, is fit for use in strictly iambic cadence. Nothing is more natural than that the least usable among them, **çṛṇávata* (since *th* at least occasionally makes position), should be remodelled. Accordingly forms like *çṛṇóta*, *juhóta*, *étana*, *kárta*, etc., are to be regarded as contracted or apostrophized from the hypothetical *çṛṇávata*, *juhávata*, etc. This may be urged with especial emphasis for the *o*-forms; for the metrical correlation of *ava* and *o* is established by many instances, which cannot be impugned. Thus the weak stem *maghon-* for *maghavan-*, *gávas* to be read for *gós*; *stonte* to be read for *stavante*, etc. Compare the contraction of *aya* in the causative to *e* in *Prākrit*; also *ava* at the beginning of words in Pāli. Cases in which original etymological *ara* and *ana* become *ar* and *an* are not, to be sure, found; but extensions of *ar* or *ra* to two syllables are well-known; and cases have been pointed out, in which *na* is to be read as *ana*.

MATHEMATICAL NOTES.

On Quaternions, Nonions, Sedenions, etc., by J. J. SYLVESTER.

1°. Suppose that m and n are two matrices of the second order.

Then if we call the determinant of the matrix $x + my + nz$,

$$x^2 + 2bxy + 2cxz + dy^2 + 2eyz + fz^2,$$

the necessary and sufficient conditions for the subsistence of the equation $nm = -mn$ is that $b = 0$, $c = 0$, $e = 0$, and if we superadded the equations $m^2 + 1 = 0$, $n^2 + 1 = 0$, then $d = 1$ and $f = 1$, or in other words in order to satisfy the equations $mn = -nm$, $m^2 = -1$, $n^2 = -1$, where it will of course be understood that in these (as in the equations $m^2 + 1 = 0$, $n^2 + 1 = 0$) 1 is the abbreviated form of the matrix $\begin{matrix}1 & 0\\ 0 & 1\end{matrix}$ and $\bar{1}$ of the form $\begin{matrix}\bar{1} & 0\\ 0 & \bar{1}\end{matrix}$, the necessary and sufficient condition is that the determinant of $x + my + nz$ shall be equal to $x^2 + y^2 + z^2$.

The simplest mode of satisfying this condition is to write $m = \begin{matrix}i & 0\\ 0 & -i\end{matrix}$, $n = \begin{matrix}0 & \bar{1}\\ \bar{1} & 0\end{matrix}$, i meaning $\sqrt{-1}$, which gives $mn = \begin{matrix}0 & i\\ i & 0\end{matrix}$ and $nm = \begin{matrix}0 & i\\ i & 0\end{matrix}$.

It is easy to express any matrix of the second order as a linear function of 1 $\left(\text{meaning } \begin{matrix}1 & 0\\ 0 & 1\end{matrix}\right)$ m, n, p, where p stands for mn.

For if $\begin{matrix}a, & b\\ c, & d\end{matrix}$ be any such matrix it is only necessary to write

$$\begin{aligned} a &= f + ig, & b &= -h - ki,\\ d &= f - ig, & c &= -h + ki, \end{aligned}$$

and then $\begin{matrix}a, & b\\ c, & d\end{matrix} = f + gm + hn + kp$.

The most general solution of the equations $MN = NM$, $M^2 = N^2 = -1$, must contain 8 arbitrary constants, viz., the difference between the number of terms in m and n, and the number of conditions $b = 0$, $c = 0$, $e = 0$, $d = 1$, $f = 1$, which are to be satisfied.

Suppose M, N to be the most general solution fulfilling these conditions; we may write

$$\begin{aligned} M &= f + gm + hn + kp,\\ N &= f' + g'm + h'n + k'p, \end{aligned}$$

where m, n is any particular solution and $p = mn$, and we shall have inasmuch as $M^2 = \bar{1}$,

$$f^2 - g^2 - h^2 - k^2 + 2fgm + 2fhn + 2fkp = \text{the matrix } \bar{1},$$

and consequently

$$\begin{aligned} g^2 + h^2 + k^2 &= 1 + f^2,\\ fg = 0, fh &= 0, fk = 0. \end{aligned}$$

Hence $f = 0$ and $g^2 + h^2 + k^2 = 1$.

Similarly $f' = 0$ and $g'^2 + h'^2 + k'^2 = 1$,

and also inasmuch as $MN = -NM$,

$$gg' + hh' + kk' = 0,$$

and since the equations $M^2 = \bar{1}$, $N^2 = 1$, $MN = -NM$ imply if we make $MN = P$ that $P^2 = -1$, and $MP = -PM$, and $NP = -PN$, it follows that M, N, P, are connected with m, n, p, in the same way as the coordinates of a point referred to one set of rectangular coordinates in space are connected with the coordinates of the same point referred to any other set of the same.*

Herein lies the ground of the geometrical interpretation to which quaternions lend themselves and it is hardly necessary to do more than advert to the fact that the theory of Quaternions is one and the same thing as that of Matrices of the second order viewed under a particular aspect.†

2°. Let m, n now denote matrices of the third order.

We might propose to solve the equation $mn = -nm$.

The result of the investigation is that we must have $m^2 = n^2$, $m^3 = 0$, $n^3 = 0$, and writing $mn = p$, $m^2 = n^2 = q$, there results a set of *quinions*, 1, m, n, p, q, for which the multiplication is that marked (a_5) p. 144 of the late Prof. Peirce's invaluable memoir in Vol. IV of the *American Journal of Mathematics*.

But instead of this let us propose the equation $mn = \rho nm$, where ρ is one of the imaginary roots of unity; if now we write the determinant of $x + my + nz$ under the form

$$x^3 + 3bx^2y + 3cx^2z + 3dx^2z + bexyz + 3fy^2z + gy^3 + 3hy^2z + 3kyz^2 + lz^3,$$

it may be shown that we must have

$$b = 0, \quad c = 0, \quad d = 0, \quad e = 0, \quad f = 0, \quad h = 0, \quad k = 0,$$

and if we superadd the conditions $m^3 = 1$, $n^3 = 1$, we must also have $g = 1$, $l = 1$, or in other words the determinant to $x + my + nz$ must take the form $x^3 + y^3 + z^3$; but this condition (or system of conditions) although necessary *is not sufficient* (a point which I omitted to notice in my article entitled "A Word on Nonions" inserted in a previous *Circular*).

It is obviously necessary that we must have $(mn)^3 = 1$.

Now if the *identical equation* to mn, be written under the form

$$(mn)^3 - 3B(mn)^2 + 3Dmn - E = 0,$$

B may be shown to be a linear homogeneous function of b, c, and e; also $E = gl = 1$; but D is not a function of $b, c, d, e, f, g, h, k, l$, and will not in general vanish (as it is here required to do) when b, c, d, e, f, h, k vanish. Its value is the sum of the products obtained on multiplying each quadratic minor of m by its *altruistic* opposite in n: [the *proper* opposite to a minor of m means the minor which is the reflected image of such minor viewed in the Principal Diagonal of m regarded as a mirror; and the *altruistic* opposite is the minor which occupies in n a position precisely similar to that of the proper opposite in m]. There are, therefore, 10 equations in all to be satisfied between the coefficients of m and n when $m^3 = n^3 = 1$ and $nm = \rho mn$.

These *ten* conditions I have demonstrated are *sufficient* as well as necessary. There remains then $18 - 10$ or 8 arbitrary constants in the general solution. If m, n is a particular solution we may take for M, N (the matrices of the general solution),

$$\begin{aligned} M = \alpha + \beta m + \gamma m^2 + \alpha' n + \beta' mn + \gamma' m^2 n &\\ + \alpha'' n^2 + \beta'' mn^2 + \gamma'' m^2 n^2&,\\ N = \alpha_1 + \beta_1 m + \gamma_1 m^2 + \alpha'_1 n + \beta'_1 mn + \gamma'_1 m^2 n &\\ + \alpha''_1 n^2 + \beta''_1 mn^2 + \gamma''_1 m^2 n^2&, \end{aligned}$$

and 10 relations between the 18 coefficients *must* be sufficient to enable to be satisfied the equations $M^3 = N^3 = 1$, $NM = \rho MN$: but what these relations are and how they may most simply be expressed I am not at present in a condition to state.*

I showed in "A Word on Nonions" that the 9 first conditions are satisfied by taking

$$m = \begin{matrix}1 & 0 & 0\\ 0 & \rho & 0\\ 0 & 0 & \rho^2\end{matrix}, \qquad n = \begin{matrix}0 & 0 & 1\\ \rho & 0 & 0\\ 0 & \rho^2 & 0\end{matrix}.$$

The 10th condition is also satisfied; for the only quadratic minors (not having a zero determinant) in m are $\begin{matrix}1 & 0\\ 0 & \rho\end{matrix}$, $\begin{matrix}\rho & 0\\ 0 & \rho^2\end{matrix}$, $\begin{matrix}1 & 0\\ 0 & \rho^2\end{matrix}$; the *altruistic opposites* to which in n are $\begin{matrix}0 & \rho\\ 0 & 0\end{matrix}$, $\begin{matrix}0 & \rho^2\\ 0 & 0\end{matrix}$, $\begin{matrix}0 & 0\\ 1 & 0\end{matrix}$, the determinants to each of which are zeros, and accordingly we find

$$m^3 = n^3 = \begin{matrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{matrix},$$

$$mn = \begin{matrix}0 & 0 & \rho^2\\ \rho & 0 & 0\\ 0 & 1 & 0\end{matrix}, \qquad nm = \begin{matrix}0 & 0 & 1\\ \rho^2 & 0 & 0\\ 0 & \rho & 0\end{matrix},$$

so that $nm = \rho mn$ and $m^3 = n^3 = 1$ as required.

I subjoin an outline proof of the fundamental portion of the theory of Quaternions and Nonions above stated as it will serve to throw much light upon the nature of the processes employed in that new world of thought to which I gave the name of Universal Algebra or the Algebra of multiple quantity: a fuller explanation will be found in the long memoir which I am preparing on the entire subject for the *American Journal of Mathematics*.

1°. As regards the equation $nm = -mn$ where m, n, are matrices of the second order.

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* There is another solution possible, obtained by writing $-\frac{f}{f'} = \frac{g}{g'} = \frac{h}{h'} = \frac{k}{k'}$, $f^2 + g^2 + h^2 + k^2 = 0$ but this leads to a linear relation between m and n, so that $mn = nm$ and consequently $mn = nm = 0$ which is not the kind of solution proposed in the question.

† See my article in the Lond. and Edin. Phil. Mag. on "Involution and Evolution of Quaternions," November, 1883.

* The solution of this problem would seem to involve some unknown expansion of the idea of orthogonalism. Unless $MN = NM = 0$, a solution to be neglected, it may be proved that $\alpha = 0$, $\alpha_1 = 0$.

As before let the determinant of $(x + ym + zn) = x^2 + 2bxy + 2cxz + dy^2 + 2eyz + fz^2$.

[I may observe here parenthetically that the Invariant of the above Quantic is equal to the determinant of $mn - nm$, and that when it vanishes $1, m, n, mn$, as also $1, n, m, nm$ are linearly related—or, as I express it, this Invariant is the Involutant of the system m, n or n, m, When m, n are of higher than the second order, the Involutant of m, n, say I, is that function whose vanishing implies that the 9 matrices $\left(1, m, m^2\right)\!\!\left(1, n, n^2\right)$ are linearly relatent, and the Involutant of n, m, say J, that function whose vanishing implies that the 9 quantities $\left(1, n, n^2\right)\!\!\left(1, m, m^2\right)$ are so related (I, J being two distinct functions) and so for matrices of any order higher than the second].

By virtue of a general theorem for any two matrices m, n of the second order, the following identities are satisfied:

$$\begin{aligned} &m^2 - 2bm + d = 0, \\ &mn + nm - 2bn - 2cm + 2e = 0, \\ &n^2 - 2cn + f = 0. \end{aligned}$$

If then $mn + nm = 0$, since m and n cannot be fractions of one another (for then $mn = nm$), the second equation shows that $b = 0$, $c = 0$, $e = 0$, and conversely if $b = 0$, $c = 0$, $e = 0$, $mn + nm = 0$, and $m^2 + d = 0$, $n^2 + f = 0$, where, if we please, we may make $d = 1, f = 1$.

2°. Let m, n be matrices of the third order, and write as before,

$$\text{Det.}\ (x + ym + zn) = x^3 + 2bx^2y + 2cx^2z + dxy^2 + 2exyz + fxz^2 + gy^3 + 3hy^2z + 3ky^2z + lz^3.$$

Then by virtue of the general theorem last referred to there exist the identical equations

$$\begin{aligned} &m^3 - 3bm^2 + 3dm - g = 0, \\ &m^2n + mnm + nm^2 - 3b(mn + nm) - 3cm^2 + 3dn + 3em - 3h = 0, \\ &mn^2 + nmn + n^2m - 3c(mn + nm) - 3bn^2 + 3fm + 3en - 3k = 0, \\ &n^3 - 3cn^2 + 3fn - l = 0. \end{aligned}$$

Let now $nm = \rho mn$, where ρ is either imaginary cube root of unity, then (1), $m^2n + mnm + nm^2 = 0$ and (2), $mn^2 + nmn + n^2m = 0$; for greater simplicity suppose also that $m^3 = n^3 = 1$, where 1 means the matrix $\begin{matrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{matrix}$.

From the 1st and 2d of the 4 identical equations combined it may be proved that $b = 0$, $d = 0$; [I do not produce the proof here because to make it *rigorous*, the theory of Nullity would have to be gone into which would occupy too much space] and in like manner from the 3d and 4th it may be shown that $c = 0$, $f = 0$[*]. Hence returning to the two middle equations it follows that $e = 0$, $h = 0$, $k = 0$, and from the two extremes that $g = 1$, $l = 1$.

If then $mn = \rho nm$, $m^3 = 1$, and $n^3 = 1$, it is necessary that

$$b = 0, \quad c = 0, \quad d = 0, \quad e = 0, \quad f = 0, \quad g = 1, \quad h = 0, \quad k = 0, \quad l = 1.$$

But these equations although not necessary are manifestly insufficient; for they lead to the equations $m^3 - 1 = 0$, $n^3 - 1 = 0$, and (1) $m^2n + mnm + nm^2 = 0$; (2) $mn^2 + nmn + n^2m = 0$, but not necessarily to $nm = \rho mn$. In fact the supposed equations between m and n involve as a consequence the equation $(mn)^3 = 1$. Now the general identical equation to (mn) is

$$(mn)^3 + 3B(mn)^2 + 3D(mn) + F = 0,$$

where $B =$ The sum of each term in m by its altruistic opposite in $n = 3bc - 2e = 0$, $F = gl = 1$, and $D =$ The sum of each first minor in m by its altruistic opposite in n which sum does not necessarily vanish when b, c, d, e, f, h, k, all vanish. Hence there is a 10th condition necessary not involved in the other 9, viz., $D = 0$. These 10 conditions I shall show are sufficient as well as necessary. For when they are satisfied since $(mn)^3 = 1$, $mn \,.\, mn = n^2m^2$.

Hence from (1) $m^2n^2 + n^2m^2 + nm^2n = 0$,
and from (2) $m^2n^2 + n^2m^2 + mn^2m = 0$.

Hence $nm \,.\, mn = mn \,.\, nm$,[†] and consequently nm is a function of mn. Hence we may write $nm = A + Bmn + C(mn)^2$.

But the *latent roots* of mn and nm (which are always identical) are $1, \rho, \rho^2$, hence $A + B + C$, $A + B\rho + C\rho^2$, $A + B\rho^2 + C\rho$, must be equal to $1, \rho, \rho^2$, each to each taken in some one of the 6 orders in which these quantities can be written.[*]

Solving these 6 systems of linear equations there results:

$$\begin{aligned} & A = 0, \qquad B = 0, \qquad C = 1, \rho \text{ or } \rho^2, \\ \text{or} \quad & A = 0, \qquad B = 1, \rho \text{ or } \rho^2, \quad C = 0. \end{aligned}$$

Hence $nm = \theta mn$, or $\theta(mn)^2$ where $\theta = 1, \rho, \rho^2$.

If $nm = \theta(mn)^2$, $nmmn = \theta(mn)^3 = \theta$.

Hence $m^2 = \theta n^2 \,.\, \theta n^2 = \theta^2 n$; and

$$m^2n + mnm + nm^2 = 3\theta m^4 = 3\theta m = 0,$$

so that $m = 0$, and $m^3 = 0 = 1$; and again if $nm = mn$,

$$m^2n + mnm + nm^2 = 2m^2n + mnm = 3m^2n = 0,$$

so that $m^3n = 0$, $n = 0$, and $n^3 = 0 = 1$ as before, where it should be noticed that $0 = 1$ means that $\begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix}$ is identical with $\begin{matrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{matrix}$.

Hence the only available hypothesis remaining is the equation $nm = v.mn$, where v is one of the imaginary cube-roots of unity as was to be proved.

3°. It remains to say a few words on the general equation $nm = kmn$, where m, n are matrices of any order ω. To avoid prolixity I shall confine my remarks to the general case, which is, that where the determinants (or as I am used to say the contents) of m and n are each of them finite; with this restriction, the proposed equation is impossible for general values of k as will be at once obvious from the fact that the totalities of the latent roots of mn and of nm are always identical, but the individual latent roots are by virtue of the proposed equation in the ratio to one another of $1 : k$, which, since by hypothesis no root is zero, is only possible when $k^\omega = 1$.

When the above equation is satisfied the ω^2 equations arising from the identification of nm with kmn cease to be incompatible and (as is necessary or at all events usual in such a contingency) become mutually involved. Thus, *ex. gr.*, when $\omega = 1$ and $k = 1$, the number of independent equations is 0, *i. e.* $1 - 1$, when $\omega = 2$ and $k = -1$ the number is 3, *i. e.* $4 - 1$, when $\omega = 3$ and $k = \rho$ or ρ^2 the number is 8, *i. e.*, $9 - 1$; it is fair therefore to presume (although the assertion requires proof) that for any value of ω when k is a primitive ωth root of unity the number of conditions to be satisfied when $nm = kmn$ is $\omega^2 - 1$. Of these the condition that the content of $x + my + nz$ shall be of the form $x^3 + cy^3 + c'z^3$ will supply $\frac{(\omega + 1)(\omega + 2)}{2} - 3$, *i. e.* $\frac{\omega^2 + 3\omega}{2} - 2$, and there will therefore be $\frac{\omega^2 - 3\omega}{2} + 1$ or $\frac{(\omega - 1)(\omega - 2)}{2}$ to be supplied from some other source.

When k is a non-primitive ωth root of unity, the number of equations of condition is no longer the same. Thus when $k = 1$ we know that n may be of the form $A + Bm + Cm^2 + \ldots Lm^{\omega - 1}$, where $A, B, \ldots L$, and all the ω^2 terms in m are arbitrary, and consequently the number of conditions for that case is $2\omega^2 - (\omega^2 + \omega)$ or $\omega^2 - \omega$. It seems then very probable that if k is a qth power of a primitive ωth root of unity the number of conditions required to satisfy $nm = kmn$ is $\omega^2 - \delta$ where δ is the greatest common measure of q and ω: but, of course, this assertion awaits confirmation.

When $\omega = 4$ besides the case of $nm = mn$, *i. e.* of n being a function of m of which the solution is known there will be two other cases to be considered, viz. $nm = -mn$ and $nm = imn$: the former probably requiring 14 and the latter 15 conditions to be satisfied between the coefficients of m, the coefficients of n and the two sets of coefficients combined.

It is worthy of notice that the conditions resulting from the content of $x + my + nz$ becoming a sum of 3 powers are incompatible with the equation $nm = vmn$ when v is other than a primitive ωth root of unity (ω being of course the order of m or n).

Thus suppose $\omega = 4$; the conditions in question applied to the middle one of the 5 identical equations give

$$m^2n^2 + n^2m^2 + mn^2m + nm^2n + mnmn + nmnm = 0;$$

when $nm = imn$ the left hand side of this equation becomes $(1 + i^4 + i^2 + i^2 + i + i^3)m^2n^2$, *i. e.* is zero, but when $nm = -nm$, the value is $(1 + 1 - 1 - 1 - 1 - 1)m^2n^2$ which is not zero, and so in general. Thus the pure power form of the content of $x + my + nz$ is a condition applicable to the case of $\frac{nm}{mn}$ being a primitive root of unity and to no other.

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[*] Except when m, n are functions of one another, so that mn and nm are identical and consequently are each of them zero.

[†] This equation is independent of the equation $(mn)^3 = 1$; for $nm^2n - mn^2m = (m^2n + mnm + nm^2)\, n - m\, (mn^2 + nmn + n^2m) = 0$ by virtue of equations (1) and (2) above: accordingly these equations taken alone imply the equations $nm = A + B_1 mn + C(mn)^2$, $mn = -A + B_2 nm - C(nm)^2$ where B_1, B_2 are the roots of $B^2 + B + 1 - \frac{AC}{2} = 0$; A, C being arbitrary and independent except that each vanishes when and only when the cube of mn and (as a consequence) of nm, is a scalar matrix.

[*] By virtue of the general theorem that the latent roots of any function of a matrix are the like functions of the latent roots of the original matrix.

The case of nm being a primitive root of ordinary unity is therefore the one which it is most interesting to thrash out.

There are in this case we have seen $\frac{\omega^2+3\omega-4}{2}$ simple conditions expressible by the vanishing of that number of coefficients in the content of $x+my+nz$ and $\frac{(\omega-1)(\omega-2)}{2}$ supplemental ones. What are these last? I think their constitution may be guessed at with a high degree of probability. For revert to the case of $\omega=3$ in which there is one such found by equating to zero the second coefficient in the identical equation

$$(mn)^3-3B(mn)^2+3Dmn-G=0.$$

Suppose now $(m^2n^2)^3-3B'(m^2n^2)^2+3D'm^2n-G'=0$ is the identical equation to m^2n^2. By virtue of the 8 conditions supposed to be satisfied we *know* that $nm=\rho mn$ as well as $m^3=1$, $n^3=1$, and consequently that $(m^2n^2)^3=1$. Hence $B'=0$, $D'=0$, by virtue of the 7 parameters in the oft-quoted content and of D being all zero, and thus the evanescence of B' or D' imports no new condition.

Now suppose $\omega=4$, and that

$$(mn)^4-4B(mn)^3+6D(mn)^2-4Gmn+M=0,$$
$$(m^2n)^4-4B'(m^2n^2)^3+6D'(m^2n^2)^2-4G'm^2n^2+M'=0.$$

Here we know that B vanishes by virtue of bc and e vanishing, but $D=0$, $G=0$, which must be satisfied if $nm=imn$ will be two new conditions not implied in those which precede. It seems then although not certain, highly probable that $B'=0$, $D'=0$, will be implied in the satisfaction of the antecedent conditions but that $G'=0$ will be an independent condition, so that $D=0$, $G=0$, $G'=0$, will be the three supplemental conditions: and again when $\omega=5$ forming the identical equations to mn, m^2n^2, m^3n^3, and using an analogous litteration to what precedes, the supplemental conditions will be $D=0$, $G=0$, $M=0$,

$$G'=0,\ M'=0,$$
$$M''=0,$$ and so in general for any value of ω.

The functions D, G, M, etc., above equated to zero are known from the following theorem of which the proof will be given in the forthcoming memoir.*

If $(\overline{mn})^{\omega}+k_1(\overline{mn})^{\omega-1}+\ldots+k_i(\overline{mn})^{\omega-i}+\ldots=0$ is the *identical equation* to mn, then k_i is equal to the sum of the product of each minor of order i in m multiplied by its *altruistic* opposite in n.

The annexed example will serve to illustrate in the case of $\omega=3$ that unless the supplemental condition is satisfied we cannot have $nm=\rho mn$.

Write
$$m=\begin{matrix}1 & 0 & 0,\\ 0 & \rho & 0,\\ 0 & 0 & \rho^2,\end{matrix}\qquad n=\begin{matrix}0 & c & k,\\ k & 0 & c\rho,\\ c\rho^2 & k & 0,\end{matrix}$$

then the determinant to $x+my+nz$ will be easily found to be $x^3+y^3+(c^3+k^3)z^3$; but D becomes $-3\rho ck$, and does not vanish unless $c=0$ or $k=0$, and accordingly we find

$$mn=\begin{matrix}0 & \rho c & \rho^2k,\\ k & 0 & c,\\ \rho^2c & \rho k & 0,\end{matrix}\qquad nm=\begin{matrix}0 & c & k,\\ \rho k & 0 & \rho^2c,\\ \rho c & \rho^2k & 0.\end{matrix}$$

When $k=0$ $mn=\rho^2nm$, when $c=0$ $nm=\rho mn$, but on no other supposition will $\frac{nm}{mn}$ be a primitive cube root of unity.

ADDENDUM.

Referring to the equation $MN=-NM$, and to the eight equations expressing M and N in terms of the combinations of the powers of m with those of n [in which it is to be understood that M and N are *non-vacuous*], we know that the sums of the latent roots of M and of N must each vanish and consequently, as may be proved, that $a=0$, $a'=0$, leaving $8-2$ or 6 conditions to be satisfied. If we further stipulate that $M^3=1$, $N^3=1$, there will be 8 relations connecting the coefficients $b, c, \ldots k$ and $b', c', \ldots k'$, so that the 64 coefficients in the 8 equations connecting M, M^2; N, N^2; MN, M^2N^2; M^2N, MN^2, or say rather M, M^2; N, N^2; ρ^2MN, $\rho^2M^2N^2$; ρM^2N, ρMN^2, with like combinations or multiples of combinations of powers of m, n† will be connected together by 56 equations; the coefficients in the expression for any one of the above 8 terms may then be arranged in pairs f_i, f_i'; g_i, g_i'; h_i, h_i'; k_i, k_i'; and in the expression for its fellow by F_i, F_i'; G_i, G_i'; H_i, H_i'; K_i, K_i'; so that the Matrix is resolved as it were into 4 sets of paired columns and 4 sets of paired lines; the 4 different sets of paired lines being found by writing successively $i=1, 2, 3, 4$.

It is then easy to see that there will be 4 equations of the form

$$\Sigma(f_\alpha G_\alpha'+f_\alpha G_\alpha')=1,$$

and 6 quaternary groups of (*i. e.* 24) equations of the form

$$\Sigma(f_\alpha G_\beta'+f_\alpha G_\beta')=0$$

[with liberty to change f into F or G into g or each into each]: together then the above are 28 of the 56 conditions required. But inasmuch as the 8 $[m, n]$ arguments may be interchanged with the 8 $[M, N]$ ones; we may transform the above equations by substituting for each letter f its conjugate $\frac{d\log\Delta}{df}$ (where Δ is the content of the Matrix) and thus obtain 28 others, giving in all (if the two sets as presumably is the case) are independent the required 56 conditions: the latter 28, however, may be replaced by others of much simpler form.*

To me it seems that this vast new science of multiple quantity soars as high above ordinary or quaternion Algebra as the Mécanique Céleste above the "Dynamics of a Particle" or a pair of particles, (if a new Tait and Steele should arise to write on the Dynamics of such pair,) and is as well entitled to the name of Universal Algebra as the Algebra of the past to the name of Universal Arithmetic.

On Involutants and other allied species of Invariants to Matrix Systems, by J. J. SYLVESTER.

To make what follows intelligible I must premise the meaning and laws of vacuity and nullity.

A matrix is said to be vacuous when its content (the determinant of the matrix) is zero, but it may have various degrees of vacuity from ω up to ω the order of the matrix.

If to each term in the principal diagonal of a matrix λ be subtracted, the content of the resulting matrix is a function of degree ω in λ; the ω values of λ which make this content vanish are called its latent roots, and if i of these roots are zero, the vacuity (treated as a number) is said to be i. This comes to the same thing as saying that the vacuity is i when the determinant, and the sums of the determinants of the principal minors of the orders $\omega-1$, $\omega-2, \ldots (\omega-i+1)$ are each zero. A principal minor of course means one which is divided into 2 triangles by the principal diagonal of the parent matrix.

Again the nullity is said to be i when *every* minor of the order $(\omega-i+1)$ [and consequently of each superior order] is zero. It follows therefore that it means the same thing to predicate a vacuity 1 and a nullity 1 of any matrix, but for any value of i greater than 1, a nullity i implies a vacuity i but not *vice versâ*; the vacuity may be i, whilst the nullity may have any value from 1 up to i inclusive.

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* This theorem furnishes as a Corollary the principle employed to prove the stability of the Solar System. (See Lond. and Edin. Phil. Mag., October, 1883.)

† It is easy to see that the sum of the latent roots of M^iN^j must be zero for all values of i, j so that it is a homogeneous linear function of the 8 quantities $m, m^2, \ldots, mn, m^2n^2$.

* I am still engaged in studying this matrix, which possesses remarkable properties Is it orthogonal? I rather think not, but that it is allied to a system of 4 pairs of somethings drawn in four mutually perpendicular hyperplanes in space of 4 dimensions. In the general case of $MN=\rho NM$ where ρ is a primitive ωth root of unity, there will be an analogous matrix of the order ω^2-1 where each line and each column will consist of $\omega+1$ groups of $\omega-1$ associated terms.

The value of the cube of any one of the 8 matrices $M, M^2; \ldots; MN, M^2N^2$ may be expressed as follows: It is P into ternary unity. [Such a quantity may be termed by analogy a Scalar.] To find $P_{i,j}$ I imagine the 8 letters corresponding to M^iN^j (but without powers of ρ attached) to be set over 8 of the 9 points of inflexion to any cubic curve the paired letters being made suitably collinear with the missing 9th point. Then among themselves the 8 letters may be taken in 8 different ways to form collinear triads and the product of the letters in each triad may be called a collinear product; $P_{i,j}$ (which is identical with the Determinant to M^iN^j) will be the sum of the cubes of the 8 letters less 3 times the sum of their 8 collinear products, and its 8 values will be analogous to the 3 values of the sum of 3 squares in the Quaternion Theory. Each of these 8 values is assumed equal to unity.

It may be not amiss to add that the product of four squares by four is representable rationally as a sum of four squares, so if we place (not now 8 specially related but) nine perfectly abitrary letters over the nine points of inflexion of a cubic curve the sum of their 9 cubes less three times their 12 collinear products multiplied by a similar function of 9 other letters may be expressed by a similar function of 9 quantities lineo-linear functions of the two preceding sets of 9 terms.

By the 8 letters of any set as *ex. gr.* $b, \ldots, h'$ being "specialized," I mean that they are subject to the condition $bb'+dd'+ff'+hh'=0$. When this equation is satisfied, and not otherwise, M^3 will be a Scalar, and it *must* be satisfied when $MN=\rho NM$.

The law of nullity which I am about to enunciate is one of paramount importance in the theory of matrices.[*]

The law is that the nullity of the product of *two* (and therefore of any number of) matrices cannot be less than the nullity of any factor nor greater than the sum of the nullities of the several factors which make up the product.

Suppose now that $\lambda_1, \lambda_2, \ldots \lambda_\omega$ are the latent roots of any matrix with unequal latent roots of the order ω. It is obvious that any such term as $m-\lambda_1$, will have the nullity 1, for its latent roots will be $0, \lambda_2-\lambda_1, \lambda_3-\lambda_1, \ldots \lambda_\omega-\lambda_1$, and consequently its *vacuity* is 1.

Moreover we know from Cayley's famous identical equation that the nullity of the product of all the ω factors is ω.

Hence it follows that if M_i contains i, and M_j the remaining $\omega-i$ of these factors (so that $i+j=\omega$), the nullity of M_i must be exactly i and of M_j exactly j.

For the theorem above stated shows that M_i cannot have a nullity greater than i, nor M_j a nullity greater than j.

Hence if the nullity of the one were less than i or of the other less than j, the nullity of M_iM_j would be less than $i+j$, *i. e.* less than ω, whereas its nullity is ω; hence the two nullities are respectively i and j as was to be shown.

Furthermore we know that the latent roots of $(m-\lambda_1)^a$ are $(\lambda_1-\lambda_1)^a$; $(\lambda_2-\lambda_1)^a; \ldots (\lambda_\omega-\lambda_1)^a$.

Hence if the latent roots of m are all distinct, the nullity of $(m-\lambda_1)^a$ is unity and consequently by the same reasoning as that above employed it follows that the nullity of $(m-\lambda_1)^{a_1}.(m-\lambda_2)^{a_2}\ldots(m-\lambda_i)^{a_i}$ is exactly i.

I will now explain what is meant by the Involutant or Involutants of a system of two matrices of like order.

It will be convenient here to introduce the term "topical resultant" of a system of ω^2 matrices each of order ω.

We may denote any matrix say

$$\begin{matrix} a_{1,1} & a_{1,2} & \ldots & a_{1,\omega} \\ a_{2,1} & a_{2,2} & \ldots & a_{2,\omega} \\ \cdot & \cdot & \cdot & \cdot \\ a_{\omega,1} & a_{\omega,2} & \ldots & a_{\omega,\omega} \end{matrix}$$

by the linear form

$$\begin{matrix} & a_{1,1}t_{1,1}+a_{1,2}t_{1,2}+\ldots+a_{1,\omega}t_{1,\omega} \\ + & a_{2,1}t_{2,1}+a_{2,2}t_{2,2}+\ldots+a_{2,\omega}t_{2,\omega} \\ & \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\ & \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\ + & a_{\omega,1}t_{\omega,1}+a_{\omega,2}t_{\omega,2}+\ldots+a_{\omega,\omega}t_{\omega,\omega} \end{matrix}$$

where the t system is the same for all matrices of the order ω. If, then, we have ω^2 such matrices, their topical resultant is the Resultant in the ordinary sense of the ω^2 linear forms above written, proper to each of them respectively.

Suppose now that m, n are two independent matrices of the order ω, we may form ω^2 matrices by taking each power of m from 0 to $\omega-1$ as an antecedent factor, and can combine it with similar powers of n as a consequent factor and in this way obtain ω^2 matrices, of which the first will be the ω-ary unity, *i. e.* a matrix of the order ω in which the principal diagonal terms are all units and the other terms all zero. The topical resultant of these ω^2 matrices I shall for brevity denote as the Involutant to m, n.

In like manner, inverting the position of the powers of m and of n so as to make the latter precede instead of following the latter in the ω^2 products above referred to, we shall obtain another topical resultant which may be termed the Involutant to n, m.

The reason why I speak of these topical resultants as involutants to m, n or n, m is the following:

In general if m, n are two independent matrices, any other matrix p, by means of solving ω^2 linear equations, may obviously be expressed as a linear function of the ω^2 products $(1, m, m^2, \ldots; m^{\omega-1})(1, n, n^2, \ldots; n^{\omega-1})$. There are, however, exceptions to this fact.

The most obvious exception is that which takes place when n is a function of m; for then any ω of the ω^2 products will be linearly related, and there will be substantially only ω disposable quantities to solve ω^2 equations.

Another exception is when the m, n Involutant, *i. e.* the topical resultant of the ω^2 matrices is zero; in which case the general values of the ω^2 disposable quantities each becomes infinite. So that m, n may be said to be in a kind of mutual involution with one another. So, again, p may in general be expressed as a linear function of the ω^2 matrices $(1, n, n^2, \ldots; n^{\omega-1})(1, m, m^2, \ldots; m^{\omega-1})$, but when the n, m Involutant vanishes this is no longer possible.

When $\omega=2$ the two involutants, considered as definite determinants, are absolutely equal in magnitude and in Algebraical sign, but when ω exceeds 2 this is no longer the case; the two Involutants are then entirely distinct functions of the elements of m and n.

Thus to take a simple example: if $m = \begin{matrix} 1 & 0 & 0 \\ 0 & \rho & 0 \\ 0 & 0 & \rho^2 \end{matrix}$ and $n = \begin{matrix} 0 & \rho & k \\ k & 0 & \rho^2 \\ 1 & k & 0 \end{matrix}$ it will be found by direct calculation of two topical resultants of the 9th order, that the two involutants will be $81\,(\rho-\rho^2)(k^3-\rho)^3$ and $81\,(\rho^2-\rho)(k^3-\rho^2)^3$ respectively. The reason why the two involutants coincide in the case of $\omega=2$ is not far to seek. It depends upon the fact of the existence of the mixed identical equation $mn+nm-2bn-2cm+2e=0$; from which it is obvious that the topical resultant of $1, m, n, nn$ is the negative of that of $1, m, n, nm$ or identical with that of $1, n, m, nm$.

By direct calculation it will be found that the Involutant m, n, or n, m, where $m = \begin{matrix} f & g \\ h & k \end{matrix}$ $n = \begin{matrix} f' & g' \\ h' & k' \end{matrix}$ is

$$-(gh'-g'h)^2+\Big((f-k)g'-(f'-k')g\Big)\Big((f-k)h'-(f'-k')h\Big),$$

which is the same thing as the content of the matrix $(mn-nm)$. It may also be shown *à priori* or by direct comparison to be identical (to a numerical factor *près*) with the Discriminant of the Determinant to the matrix $(x+ym+zn)$ which is a ternary quantic of the second order. Its actual value is 4 times that discriminant.

Let us consider the analogous case of Mechanical Involution of lines in a plane or in space. There are two questions to be solved. The one is to find the condition that the Involution may exist, *i. e.*, that a set of equilibrating forces admit of being found to act along the lines; the second, to determine the relative magnitudes of the forces when the involution exists, and this is the simpler question of the two.

In like manner we may consider two questions in the case of m, n being in either of the two kinds of involution; the one being to find what the condition is of such involution existing, the other what are the coefficients of the ω^2 coefficients in the equation which connects the ω^2 products, when the involution exists.

This latter part of the question (surprising as the assertion may appear and is) admits of a very simple and absolutely general direct and almost instantaneous solution by means of the Law of Nullity, above referred to, as I will proceed to show.

The determination of the Involutants, or at all events of their product, will then be seen to follow as an immediate consequence from this prior determination of the form of the equations which expresses the involution of the two kinds respectively.

But first it may be well to explain why and in what sense I refer in the title to Involutants as belonging to a class of invariants. I say, then, that universally involutants are invariants in this sense, that if any function of m and any function of n, any function of m, or any function of n be substituted, the ratio of the two Involutants, say I and J, remains unaltered. By virtue of the Identical Equation $(m)^i$ will be of the form of $A_i+B_i+C_im^2+\ldots+L_im^{\omega-1}$ and as a consequence it is easy to see that when m^i is substituted for m, I and J will become respectively PI, PJ where P is the ωth power of the determinant to the matrix formed by writing under one another the $(\omega-1)$ lines of terms, of which the line B_i; $C_i, \ldots; L_i$ is the general expression.

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[*] The three cardinal laws or landmarks in the science of multiple quantity are (1) the laws of *nullity*, (2) the law of *latency*, viz., that if $\lambda_1, \lambda_2, \ldots. \lambda_\omega$ are the latent roots of m, then $f\lambda_1, f\lambda_2, \ldots f\lambda_\omega$ are those of ρm including as a consequence that

$$fm = \Sigma f\lambda_1 \frac{(\lambda-\lambda_2)(\lambda-\lambda_3)\ldots(\lambda-\lambda_\omega)}{(\lambda_1-\lambda_2)(\lambda_1-\lambda_3)\ldots(\lambda_1-\lambda_\omega)},$$

and (3) the law of *identity*, viz., that the powers and combinations of powers of two matrices m, n of the order ω are connected together by $(\omega+1)$ equations whose coefficients are all included among the coefficients of the determinant to the Matrix

$$x+ym+zn.$$

Moreover, in the particular case where $\omega=2$ and $I=J$[*] besides being an Invariant in this modified sense I will be an invariant in a sense including but transcending the more ordinary conception of an Invariant; for if when for m and n $f(m, n)$ $\phi(m, n)$ are substituted I becomes I', then I' will contain I as a factor; this is a consequence of the fact that when m and n are in involution $f(m, n)$ and $\phi(m, n)$ will also be in involution, for in consequence of the identical equation $mn+nm-2bn-2cm+2e=0$ f and ϕ and $f\phi$ will each be reducible to the forms $A+Bm+Cn+Dmn$ and it is obvious from the ordinary theory of the determinants that the topical resultant of 1, $\left[\text{meaning } \begin{matrix}1 & 0\\ 0 & 1\end{matrix}\right]$ and three linear functions of 1, m, n, nm, will contain as a factor the topical resultant of 1, m, n, mn.

Nor must it be supposed that Involutants are the only species of invariants in the modified sense first described which appertain to the system m and n. Thus *ex. gr.* when $\omega=2$ it is not only true that the determinant of the matrix $mn-nm$ is such a kind of Invariant (which for greater clearness it may be desirable to denote by the term Perpetuitant[†]), but each element of that matrix will also be a perpetutant, and these 4 perpetutants, when for m, n $\rho m, \phi n$ are substituted, will be in an invariable ratio to one another and to either square root of the Involutant.

In like manner it will eventually be seen that for two matrices m, n of any order ω, it is possible to form a matrix of the order ω analogous to $mn-nm$ (which be it observed may be regarded as the Determinant of the matrix $\left.\begin{matrix}m & n\\ m & n\end{matrix}\right)$ each of whose ω^2 terms will be in a constant ratio to each other and to any ωth root of I and of J.

I will now return to the problem of finding what is the form of the equation which connects the ω^2 matrices denoted by $(1, m, m^2, \ldots m^{\omega-1})$ $(1, n, n^2, \ldots n^{\omega-1})$ when such an equation admits of being formed, *i. e.* $I=0$.

To fix the ideas let us suppose that m, n are matrices of the 3d order of perfectly general form so that the m, n involution necessitates the satisfaction of one single condition, $I=0$.

Let $A+Bn+Cn^2=0$ be the equation whose form is to be determined where A, B, C, are each of them quadratic functions of m. I say that neither A, B, nor C, can contain a non-vacuous linear factor. For suppose that any one of them as A should contain the non-vacuous factor $m+q$, and that $A=(m+q)(am+p)$.

Then we may multiply the equation by $(m+q)^{-1}$ and thus obtain the equation $(am+p)+B'n+C'n^2=0$, *i. e.* we have an equation in which not all 9 but only 8 of the terms signified by $(1, m, m^2)(1, n, n^2)=0$ are linearly related. But this obviously implies, contrary to the hypothesis, the existence of two equations of condition instead of one.

Hence then A, must be of the form $c(m-\lambda)(m-\lambda')$ where λ, λ' are each of them a latent root of m; whether the same or different remains to be determined.

In like manner it may be shown that B is of the form $c_1(m-\lambda_1)$ $(m-\lambda_1')$ and C of the form $c_2(n-\lambda_2)(m-\lambda_2')$. But now I say further that $(m-\lambda)(m-\lambda')$, $(m-\lambda_1)(m-\lambda_1')$, $(m-\lambda_2)(m-\lambda_2')$ must be identical.

For 1° suppose that any one pair of the λ's, say λ, λ', are distinct. If any other pair, say λ_2, λ_2', is not identical with this pair on multiplying the equation by $m-\lambda''$ where λ'' is the 3d latent root of M, the term containing the term $A(\lambda-\lambda'')$ will vanish, but $B(\lambda-\lambda'')$ will not vanish and consequently there will be an equation if $C(\lambda-\lambda'')$ does not vanish between 6 only and if $C(\lambda-\lambda'')$ does vanish between 8 only of the 9 terms denoted by $(1, m, m^2)(1, n, n^2)$ contrary to hypothesis.

The only remaining supposition is that A, B, C are each perfect squares. Suppose, then, that any one of them as A is a multiple of $(m-\lambda)^2$, unless B, C are each of them also multiples of the same on multiplying the equation by $(m-\lambda')(m-\lambda'')$, one of the three coefficients of $1, n, n^2$ will vanish but one at least of the other two will not vanish, which is impossible for the same reason as before. Hence the left-hand side of the equation of involution must contain $(m-\lambda)(m-\lambda')$ as a sinister factor where λ, λ' (whether the same or different) are latent roots of λ. And in like manner precisely, by arranging the equation of involution under the form $A'+mB'+m^2C'$ where A', B', C' are quadratic functions of n, it may be found that the same function must contain $(n-\mu)(n-\mu')$ where μ, μ' are latent roots of n as a dexter factor.

Hence the form of the equation must be

$$(m-\lambda)(m-\lambda')(n-\mu)(n-\mu')=0.$$

It is easy to see that we cannot have λ and λ' the same latent root of m and at the same time μ, μ' the same latent root of n, for then the above product would have at almost the nullity 2 whereas it is an absolute null, *i. e.* has the nullity 3.

But I will now show that λ, λ' and μ, μ' must each consist of unlike roots. Let t be any term of the matrix $(m-\lambda)(m-\lambda')(n-\mu)(n-\mu')$ where t will be a known function of the elements of m, n, of λ, λ' entering symmetrically, and of μ, μ' also entering symmetrically: this is the same thing as saying that t will be a function of the elements of m and n, of λ'', μ'', and of the coefficients of the equations which contain the 3 latent roots of λ and μ respectively.

Consequently the product of the 9 values of t found by writing λ'', λ', λ for λ'', and μ'', μ', μ for μ'' will be a rational integer function of the elements of m, n which vanishes when the Involutant I vanishes and must consequently contain I as a factor. If then, *in any single instance*, the matrix $(m-\lambda)^2(n-\mu')(n-\mu'')$ does not vanish for some one value of λ and μ when I vanishes, it cannot be the form [or *one of two* conceivably possible coexisting forms] of the left hand side of the general equation of involution. A similar remark of course applies to

$$(m-\lambda_1)(m-\lambda_2)(n-\mu_1)^2.$$

$$\text{Let now } m=\begin{matrix}1 & 0 & 0\\ 0 & \rho & 0\\ 0 & 0 & \rho^2\end{matrix},\ n=\begin{matrix}0 & \rho & k\\ k & 0 & \rho^2\\ 1 & k & 0\end{matrix}.$$

The latent roots of m are $1, \rho, \rho^2$, and of n are $\theta, \rho\theta, \rho^2\theta$, where $\theta=\sqrt[3]{1+k^3}$; we have also

$$m^2=\begin{matrix}1 & 0 & 0\\ 0 & \rho^2 & 0\\ 0 & 0 & \rho\end{matrix},\qquad n^2=\begin{matrix}-\rho^2k & k^2 & 1\\ \rho^2 & -k & k^2\\ k^2 & \rho & -\rho k\end{matrix}.$$

The three values of $(m-\lambda')(m-\lambda'')$ are

$$\begin{matrix}3 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & 0\end{matrix},\qquad \begin{matrix}0 & 0 & 0\\ 0 & 3\rho^2 & 0\\ 0 & 0 & 3\rho\end{matrix},\qquad \begin{matrix}0 & 0 & 0\\ 0 & 3\rho & 0\\ 0 & 0 & 3\rho^2\end{matrix},$$

and the three values of $(n-\mu_1)(n-\mu_2)$ are

$$\left|\begin{matrix}-\rho^2k+\theta^2 & k^2+\rho\theta & 1+\theta k\\ \rho^2+\theta k & -k+\theta^2 & k^2+\rho^2\theta\\ k^2+\theta & \rho+\theta k & -\rho k+\theta^2\end{matrix}\right| \left|\begin{matrix}-\rho^2k+\rho^2\theta^2 & k^2+\rho^2\theta & 1+\rho\theta k\\ \rho^2+\rho\theta k & -k+\rho^2\theta^2 & k^2+\theta\\ k^2+\rho\theta & \rho+\rho\theta k & -\rho k+\rho^2\theta^2\end{matrix}\right|$$

$$\left|\begin{matrix}-\rho^2k+\rho^2\theta & k^2+\theta & 1+\rho^2\theta k\\ \rho^2+\rho^2\theta k & -k+\rho\theta^2 & k^2+\rho\theta\\ k^2+\rho^2\theta & \rho+\rho^2\theta k & -\rho k+\rho\theta^2\end{matrix}\right|.$$

The general value of $(m-\lambda_1)(m-\lambda_2)(n-\mu_1)(n-\mu_2)$ will (to a numerical factor *près*) be a matrix consisting of a single column accompanied by two columns of zeros, the non-zero column being some one of the 9 columns found in the above 3 matrices.

Now by direct calculation we know that the m, n Involutant in this case is a numerical multiple of $(k^3-\rho^2)^3$ and vanishes when $k^3=\rho^2$, which gives $\theta=\sqrt[3]{1+\rho^2}$, *i. e.* $-\rho=\theta^3$ and if we please $k=\theta^2$.

Hence not merely one but three of the products of $(m-\lambda')(m-\lambda''$ $(n-\mu')(n-\mu'')$ will in this case vanish, for the above equations will cause the 2d, 4th and 9th columns all to become columns of nulls.

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[*] I for some time had imagined, and indeed thought I had proved, that the two involutants were always identical. When crossing the Atlantic last month on board the Arizona, having hit upon a pair of matrices of the third order, for which the two topical resultants admitted of easy calculation, I found, to my surprise, that they were perfectly distinct. The cause of the failure of the supposed proof constitutes a paradox which will form the subject of a communication to a future meeting of the Johns Hopkins Mathematical Society.

I will here only promise that the seeming contradiction between the logical conclusion and the facts of the case takes its rise in a sort of mirage with which invariantists are familiar, viz.: the apparent *à priori* establishment of algebraical forms as the result of perfectly valid processes, which forms have no more real existence in nature than the Corona of the Sun under our Dr. Hastings' scrutinizing gaze: the contradiction between the logical inference and the truth being accounted for by the circumstance that any such supposed form on actual performance of the operations indicated, turns out to be a congeries of terms, each affected with a null coefficient; we are thus taught the lesson that all *à priori* reasoning until submitted to the test of experience, is liable to be fallacious, and it is impossible to prove that a proof may not be erroneous by any other method than that of actual trial of the results which it is supposed to yield.

[†] *Perpetuitant* formed from *perpetuity* by analogy to Annuitant from Annuity. Perpetuant would have been better, but that it has already been applied by myself in the theory of Invariants in a sense recognized and adopted by Cayley, Hammond, and MacMahon.

If now instead of the factor $(m-\lambda')(m-\lambda'')$ we substitute the factor $(m-\lambda)^2$, the three values of $(m-\lambda)^2$ will become

$$\begin{matrix} 0 & 0 & 0 \\ 0 & -3\rho & 0 \\ 0 & 0 & -3\rho^2 \end{matrix} \qquad \begin{matrix} -3 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -3\rho^2 \end{matrix} \qquad \begin{matrix} -3 & 0 & 0 \\ 0 & -3\rho & 0 \\ 0 & 0 & 0 \end{matrix}$$

so that if $(m-\lambda)^2(n-\mu')(n-\mu'')$ is to vanish, it will readily be seen that each of two columns of one or the other of the two matrices representing $(n-\mu')(n-\mu'')$ will have to vanish simultaneously, and that this cannot be brought to pass when $\theta^3 = -\rho$ and $k^3 = \rho^2 = \theta^6$ whether we make $k = \theta^2$ or $-\theta^5$ or θ^8.

Hence $(m-\lambda)^2(n-\mu')(n-\mu'') = 0$ is not an admissible general involution form of equation. Similarly by interchanging the above special values assigned to m and n, it may be shown that $(m-\lambda')(m-\lambda'')(n-\mu)^2 = 0$ is not an admissible form, and consequently that the one universal form of the involution equation is expressed by saying that $(m-\lambda')(m-\lambda'')(n-\mu')(n-\mu'')$ is an absolute null. If no connexion exists between the elements of m and n, we know from the law of nullity that the above matrix has a nullity 2, *i. e.* that all its minors except the elements themselves have zero contents. The effect of the vanishing of I is to make the elements themselves one and all vanish when the two sets of latent roots are duly selected.

So in general if $F = \lambda^\omega - A_1\lambda^{\omega-1} + A_2\lambda^{\omega-2} - A_3\lambda^{\omega-3} \ldots = 0$,
and $G = \mu^\omega - B_1\mu^{\omega-1} + B_2u^{\omega-2} - B_3u^{\omega-3} \ldots = 0$,
are the two equations to the latent roots of m, n matrices of order ω, and if

$$M = m^{\omega-1} - (A_1-\lambda)m^{\omega-2} + (A_2 - A_1\lambda + \lambda^2)m^{\omega-3} \ldots$$

and $$N = n^{\omega-1} - (B_1-\mu)n^{\omega-2} + (B_2 - B_1\lambda + \lambda^2)n^{\omega-3} \ldots$$

$MN = 0$ for some value of λ and of μ is the one equation of involution, and $NM = 0$ for some value of λ and some value of μ is the other such equation.

I will now show how to deduce from the above statement the following marvellous theorem.

Let H represent the sum of the product of each term in the matrix M by its *altruistic opposite* in N (so that H is a function of λ and μ and of degree $\omega - 1$ in each of them) then will the ordinary Algebraical Resultant of F, G, H* be exactly equal (in magnitude as well as form) to the product of the two involutants to the *corpus* m, n.†

(To be continued in the following number of the Circular.)

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* The system of equations whose resultant expresses the undifferentiated condition of involution, may be written under the form $(x, y)^\omega = 0$; $(z, t)^\omega = 0$; $(x, y)^{\omega-1} = 0$. *Quære* whether such a resultant may not be writ under the form of a determinant by an application of the Dialytic Method?

† If I and J be the two involutants $I = 0$ will be the condition of left-handed involution of m, n or right-handed of n, m and $J = 0$ of right-handed involution of m, n or left-handed of m, m, for Involution, like light, "has sides." But $IJ = 0$ will be the condition of *one* or *the other* kind, or so to say of undifferentiated Involution.

On Quadruple Theta-Functions, by T. CRAIG.

[Abstract of a paper in the *American Journal of Mathematics*, Vol. VI, No. 1].

This paper is intended simply as an introduction to the theory of theta-functions of four variables. The method of investigation is that used by Prof. Cayley in his well-known memoir on the single and double theta-functions. In the first part of the paper the formulae connected with the decomposition of a characteristic into the sum of two others are given, and the two known equations arrived at, viz.,

$$\vartheta\begin{pmatrix} a+2x \\ \beta+2y \end{pmatrix}(u) = (-)^{\Sigma\beta y}\vartheta\begin{pmatrix} a \\ \beta \end{pmatrix}u,$$

$$\vartheta\begin{pmatrix} a \\ \beta \end{pmatrix}(-u) = (-)^{\Sigma a\beta}\vartheta\begin{pmatrix} a \\ \beta \end{pmatrix}(u),$$

$\vartheta\begin{pmatrix} a \\ \beta \end{pmatrix}(u)$ being written for brevity to denote

$$\vartheta\begin{pmatrix} a_1 a_2 a_3 a_4 \\ \beta_1 \beta_2 \beta_3 \beta_4 \end{pmatrix}(u_1, u_2, u_3, u_4).$$

The second deals with the true and quasi periods, and contains a symmetrically arranged table of the even and odd functions. The product theorem is then given in the form

$$\vartheta\begin{pmatrix} a \\ \beta \end{pmatrix}(u+u')\vartheta\begin{pmatrix} a' \\ \beta' \end{pmatrix}(u-u') =$$
$$\Sigma\Theta\begin{pmatrix} \tfrac{1}{2}(a+a')+p \\ \beta+\beta' \end{pmatrix}(2u)\Theta\begin{pmatrix} \tfrac{1}{2}(a-a')+p \\ \beta-\beta' \end{pmatrix}(2u').$$

Θ is written to denote that the coefficients a_{ik} in the exponent of ϑ are replaced here by $2a_{ik}$. There are sixteen terms in the sum corresponding to

$$p \equiv p_1, p_2, p_3, p_4 = 0, 1.$$

The 256 square-products are given in sixteen tables, a square-product meaning such a product as

$$\vartheta\begin{pmatrix} a \\ \beta \end{pmatrix}(u+u')\vartheta\begin{pmatrix} a \\ \beta \end{pmatrix}(u-u'),$$

i. e., where both factors have the same characteristic. Sixteen more tables are given for the determination of the relations among the zero values of the even functions. The present paper will be at once followed by Part II dealing with the linear relations connecting the squares of the quadruple theta-functions.

NOTES IN PHILOSOPHY.

The Philosophical Conception of Life, by G. S. MORRIS.

[Abstract of a paper read before the University Metaphysical Club, October 9, 1883].

The writer first briefly substantiated the view that all attempted explanations of life in terms of what is conceived as "mere matter" and motion, or of mere "force," have always been and must ever remain fruitless, so far as it is a question of recognizing and demonstrating the characteristic and essential nature of life itself, and not simply the laws of certain of its sensible manifestations. Matter, motion, and force presuppose life; or, life is their logical and ontological *prius*, and is not, therefore, to be conceived as their mechanical product.

It was then argued (1) that all life is an activity. (2) This activity has in every case a definite and specific character, law, or direction. It is typical, or conforms to a specific type, which is to it as its *idèe directrice.* (8) The activity of life is thus teleological. The type, by which it is defined, is realized in and through the activity; it is the "end," in which the activity is completed. (4) The activity in question is thus also ideally determined, at least in form; and, what is more important to notice, the *form* of any, even the lowest, process of life is one of self-determination, or of self-realization; the type, the law, the idea, has the air of giving to itself its own concrete realization. It is this appearance of spontaneous, independent, and ideally directed activity, that gives to nature its true poetic charm for human intelligence; and it is indeed this, also, that renders nature, in the exact and complete sense of the expression, an intelligible object for man. (5) To the *form* of *self*-realization the proper corresponding *substance* is self-conscious will, or will permeated by, and organically one with, conscious intelligence. This, of which the life of nature, as above characterized, must be held to be prophetic, is found in man, who, in his character as a consciously self-determining and self-realizing spirit, is to be viewed as illustrating in greater fulness and completeness than any other created being known to man, the true and concrete nature of life. In all life that which truly lives and is, is something ideal, some truth—in the lower grades some law, idea, or type—working itself out into reality, and sustaining itself therein, by an apparently independent and self-directed, active process. In man this "something ideal," this truth, has consciousness of itself, and its independence and self-direction subsist, or are to subsist, not only in form, but also in substance and in full reality.

Attention was then called to the fact that the truth, of which the higher life of men is to be the expression and (in its measure) the realization, is not merely single and particular, like the "idea" of the tree, or of the human body. It is not simply *some* truth, *some* ideal, but *the* truth, *the* ideal, universally, that in some way and essential measure he must realize or actively share in, in order that he may lead the truer life of the spirit. Its centre is therefore not in the individual, but outside of him; and it realizes and manifests itself, first of all, as an organizing principle of society—in family, in civil relations, in the state, and in the great movement of history—in and through which the spiritual personality of the individual lives and thrives, and separated from which, he would run the risk of speedy decay. But in none of these shapes does the truth manifest itself in an absolutely independent life. This life it must be held to lead in God, as Absolute Spirit, in whom, accordingly, all the dependent life of nature—but especially the self-conscious life of the human spirit—finds its true centre; so that the perfect life of man is to know God, as the living Truth, and, by doing his will, ("walking in the truth,") to share in his life.

CURRENT INFORMATION.

Resignation of Professor Sylvester.

It will be seen from the following official action, that Professor Sylvester has asked leave to resign his Professorship of Mathematics in the Johns Hopkins University, and has been elected *Professor Emeritus*. He has returned from Europe and will continue to discharge the duties of his chair until the beginning of next year.

Action of the Trustees.

"At a meeting of the Trustees of the Johns Hopkins University, held October 1, 1883, a letter from Professor Sylvester to President Gilman, dated London, September 12, 1883, was read to the Board, containing his resignation of the Professorship of Mathematics in the Johns Hopkins University, to take effect on the first day of January next, and expressing the unfailing and deep interest which he feels in the continued well doing of the University.

"Whereupon it was

"*Resolved*, That as this resignation is doubtless the result of mature reflection on the part of Professor Sylvester, it is hereby accepted, but that in doing so the Board of Trustees cordially extend to him its hearty thanks for the invaluable services which he has rendered to the University, and also its profound sense of the great ability, the conscientious fidelity and untiring energy with which he has discharged the arduous duties of his chair, thereby elevating the science of Mathematics to its proper plane, not only in this institution but in this country.

"It was also *Resolved*, That Professor Sylvester be and he is hereby appointed Professor Emeritus in the Johns Hopkins University."

The American School at Athens.

Professor Gildersleeve has declined the appointment to be Director of the American School at Athens, which was made by the Committee without consulting him.

Correspondence.

Extract from a letter to Professor Sylvester *by* Professor Cayley.

"... Would it surprise you to learn that the number of sextic perpetuants for any weight *w* whatever is $= 0$? I get this out (subject to one weak point in my demonstration), viz., in the equation

$$\left\{6\right\}+\left\{4.2\right\}+\left\{3.3\right\}+\left\{2.2.2\right\}=\frac{x^6}{2.3.4.5.6}+S,$$

(your theory as corrected by Hammond), I find $S=\dfrac{x^6+x^{13}-2x^{16}-x^{18}}{2.3.4.5.6}$, which, with the known values of $\left\{4.2\right\}$, $\left\{3.3\right\}$ and $\left\{2.2.2\right\}$ gives $\left\{6\right\}=0$. And if no sextic perpetuant—then *I presume* (but have not considered this) no perpetuant of any higher degree.

It seems to me there is no *à priori* objection to this result. Consider for an equation of an indefinite order, the symmetrical functions, represented in the usual manner by a partition-symbol $1=\Sigma a$, $11=\Sigma a\beta$, $2=\Sigma a^2$, &c., then any symmetrical function whatever = Rational and integral function of 1, 11, 111, &c.

In the seminvariant theory, instead of any partition-symbols whatever, we have the non-unitary symbols, 2, 22, &c., 3, 32, 33, &c., ... and the theorem would be: Any non-unitary symmetrical function = Rational and integral function of 2, 22, 222, 3, 33, &c., 5, 54, &c., with no figure exceeding 5.

Curious if true—but why not? ..."

Peabody Institute Lectures.

A general course of thirty lectures will be given in Peabody Hall, every Tuesday and Thursday evening at 8 o'clock, from November 6 to February 28, with a recess of two weeks at Christmas.

[Reprinted from the Peabody Institute Calendar for 1883-4.]

I. Rev. John C. Eccleston, D. D., of Staten Island. Four illustrated lectures, Nov. 6, 8, 13, 15, on *The Crusades*.

1. The First Crusade, from the march of Peter the Hermit in 1096 till the investment of Jerusalem in 1099; 2. The Second and Third Crusades, from the capture of Jerusalem in 1099 till its re-capture by Saladin in 1187; 3. The Third and Fourth Crusades, from the departure of Richard Cœur de Lion in 1189 till the capture of Constantinople in 1204; 4. Fifth, Sixth, Seventh, and Eighth Crusades, from the invasion of Egypt in 1218 till the fall of Acre in 1291.

These lectures will be illustrated by a large number of lantern views taken from "Gustave Dore's magnificent illustrations of Michaud's Crusades.

II. Dr. H. Newell Martin, of Johns Hopkins University. Four illustrated lectures, Nov. 20, 22, 27, 29, on *The Minds of Animals*.

1. Instinct and Reason; 2. The minds of Social insects—ants, bees, and wasps; 3. Reason and Instinct in the higher animals; 4. Emotions and the moral sense in animals.

III. Mr. Wm. I. Marshall, of Fitchburg, Mass., but for ten years a resident of the Rocky Mountain region, visiting the parks, living among the miners as one of them, and travelling through the mountains from British America to the Yosemite Valley. Six illustrated lectures, Dec. 4, 6, 11, 13, 18, 20, on *The Wonders of the Rocky Mountains*.

1 and 2. The Yellowstone National Park; 3 and 4. Gold mines and Gold mining; 5. The Yosemite Valley and the Big Trees; 6. Colorado.

These lectures will be illustrated by numerous lantern projections taken from the object represented.

IV. Prof. Edward S. Morse, of Salem, Mass., for several years a resident of Japan and a professor in the University of Tokio. Six illustrated lectures Jan. 8, 10, 15, 17, 22, 24, on *Life in Japan*.

1. Japanese Homes and their Surroundings; 2. Temples, Theatres, Music; 3. City Life and Health Matters; 4. Educational Matters and Students; 5. Keramic and Pictorial Art; 6. Antiquities.

These lectures will be illustrated by free hand drawings on the blackboard and by lantern views.

V. Mr. Locke Richardson, of New Jersey. Four lectures with recitals, Jan 29, 31, Feb. 5, 7, on *Shakspere's Plays*.

1. Macbeth; 2. Julius Cæsar; 3. Twelfth Night; 4. King Lear.

Mr. Richardson presents a condensed version of each play, reciting the principal scenes, which he connects together by a thread of narrative, and elucidates by explanatory and critical remarks.

VI. Prof. S. P. Langley, of Allegheny Observatory. Six illustrated lectures, Feb. 12, 14, 19, 21, 26, 28, on *The Sun and Stars*.

1. Size and Distance of the Sun; 2. The Solar Surface; 3. Solar Heat; 4. Solar Light 5. Eclipses; 6. The Stars.

These lectures will be thoroughly illustrated by stereopticon views representing the telescopic appearances of the Sun and Stars.

NOTES ON RECENT PUBLICATIONS

BY MEMBERS OF THIS UNIVERSITY.

Brooks, W. K. The Law of Heredity. A Study of the Cause of Variation, and the Origin of Living Organisms. (*Baltimore: J. Murphy & Co. 348 pp., 12mo. $2.00*).

The aim of this book is to disentangle from our stores of recorded facts, a clew to the nature and causes of Heredity; that is, the nature and causes of the power of each organism to produce offspring which are essentially like itself, while they also exhibit those slight differences which lead, as they have led in the past, to the endless diversity of living things and to the more and more perfect adaptation of each organism to the world around it.

According to accepted authorities, all the characteristics of a species are transmitted by each parent, and the ovum and male cell are alike in function. The author shows that there is no proof of this view, while he gives many reasons for holding its opposite, and for believing that the two reproductive elements play very different parts in heredity. Among other proofs he instances the fact that when two species or varieties are crossed reciprocally, the offspring of the male of A and the female of B is usually quite different from the offspring of the female of A with the male of B; and also the fact that while a male cell has never been observed to develop without union with an egg, the development of unfertilized eggs into perfect animals, both male and female, is not at all unusual, since certain animals have been reared through many generations of fertile females, without the presence of a single male.

The evidence furnished by the study of variation, of hybrids, of the secondary sexual characters of animals, and of the intellectual differences between men and women, is examined, at some length, in order to discover the nature of the difference in the functions of the reproductive elements, and as the result of this examination the author concludes that the established hereditary characteristics of the species are transmitted by the ovum, while new variations are due to the influence of the male element. He holds that the female factor is conservative and the male progressive.

Among the many facts presented in proof of this are the following: the offspring of a male hybrid and a female of either pure parent form is more variable than the offspring of a female hybrid with the male of either parent form; in reciprocal hybrids the recently acquired characteristics of the species used as the father predominate; variation is extremely rare in organisms produced asexually, so rare that there is an obvious connection, although it is not an absolute one, between variation and sexual reproduction; an organ which is confined to males is more variable than one confined to females; an organ which is excessively developed in males alone, or one which is peculiarly useful to males, is more variable than one which is excessively developed or most useful in females; the males of allied species or varieties differ more than the females; the mature male differs more than the mature female from the young; males are more variable than females; and so forth.

Having given proof of the existence of divergent specialization in the functions of the reproductive elements, the author attempts to trace the way in which this specialization has originated, and he is led to the conclusion that natural selection has so acted as to evolve a secondary law, the law of heredity, and that, in all the higher organisms the modification of species is, at present, chiefly due to the direct action of this law, and only indirectly to natural selection.

Briefly stated the law of heredity is this: The ovum has, by direct inheritance from the ovum of the preceding generation, power to transmit all the established hereditary characteristics of the race; Each cell of the body of a many-celled organism has the power to form cell-germs or gemmules, but this power is not exercised so long as a cell is in harmony with its environment; When a change in any cell is needed, this cell throws off gemmules which are stored up in the male reproductive element, and are thus transmitted to the fertilized ovum; Their union with the ovum, or conjugation, causes variation in the corresponding cells of the offspring; The ovarian ova derived from the fertilized ovum inherit the same tendency, and a new hereditary congenital variation is thus presented for the action of natural selection.

In the concluding chapters, the author points out that our conception of the action of natural selection is greatly simplified by the recognition of the law of heredity, and that the acceptance of the latter law does away with most of the objections which have been urged against the law of natural selection.

Adams, H. B. Village Communities of Cape Anne and Salem. Reprinted from the Historical Collections of the Essex Institute. (*Nos. 9 and 10 of the "Studies in Historical and Political Science." 81 pp., 8o*).

This monograph on the oldest village-republic of the Massachusetts Colony comprises six minor Studies, which have appeared in separate form during the past two years in the Historical Collections of the Essex Institute. The first of these Studies, "The Fisher Plantation at Cape Anne," was reported in the *University Circular, No.* 12, *December*, 1881. The second Study on "The Origin of Salem Plantation," shows the evolution of this Town from the Cape Anne germ. The so-called Old Planters, who in 1626 removed from the region of "Fishermen Fields" in the present Town of Gloucester to the "pleasant and fruitful neck of land" called Naumkeag by the Indians, were the first settlers of Salem. The Indian clearing, the open Mark, was the basis of the new Village Community. There, as one of the first settlers testified, "the English and the Indians had a feild in comon fenced in together."

The third paper, on the "Allotments of Land in Salem to Men, Women, and Maids," treats of the distribution of house and land lots for tillage. The house lots were usually small, varying from a quarter of an acre to an acre. The normal amount of planting land allotted to an individual was ten acres. It was ordered that the least family should have ten acres, but greater families, more, according to the number of persons in the household. Widows received their individual share of ten acres, with ten more for every son. "Maids lotts" were at first granted, but it was finally determined to avoid "all presedents & evil events of graunting lotts vnto single maidens not disposed of in marriage."

The paper on "Common Fields in Salem" describes the reproduction of the old English system of associate tillage. Individual owners of planting lands fenced in common and determined by a majority vote how they should plant and when they should harvest the common field. There were no less than ten such common fields in Salem as early as 1640. Old North Fields and South Fields are still spoken of by ancient inhabitants. The original manuscript records of the South Field Proprietary were found in Salem by the author of this paper and have been utilized for illustrating old agrarian customs. The article on "Salem Meadows, Woodland, and Town Neck" demonstrates that the meadows, or grass lands, were originally, as in New Plymouth, absolutely common to the Town; and when they were finally allotted to the inhabitants, the meadows were "proportioned out vnto them according to the heads of their families." Woodland was also originally held in absolute commonage. As in Plymouth, no timber, wood, or boards could be sold or transported out of Town. The Town Neck was a stinted Town Pasture, near the Village, "for milch cows and riding horses." Such a pasture in old England is termed a *Ham*. The Town Neck continued to be used as a Home pasture by the Town of Salem down to the time of the present generation, and it is still used as an open-air nursery for Salem children, for the Town Neck has been converted into a public pleasure-ground, with booths and merry-go-rounds. Salem once had village shepherds, herdsmen, swineherds like Gurth and Eumaeus, town flocks, town herds, and even town dogs for hunting wolves.

The sixth paper on "The Great Pastures" treats of a remarkable case of agrarian survival from the original pastoral domain of the Town of Salem. There are to this day within Salem limits some three hundred acres of common land called the Great Pastures, and owned by the heirs or descendants of the original settlers. This tract is the last remnant of the great "Range," once embracing about four thousand acres and extending over the towns of Peabody and Danvers. The history of the gradual break-up of this *ager publicus* or folk-land of Salem is traced in detail. It is shown that precisely the same agrarian questions which agitated the plebeians and patricians of Rome once disturbed the cottagers and commoners of this little village-republic of Salem. The cottagers were new comers and landless men; the commoners were the descendants of old comers and were proprietors of the commons. The village-patricians yielded gradually to the demands of the *plebs*, but the struggle was long and bitter. The witch trials, which occurred only a few years before the passage of Salem's agrarian laws, were of far less consequence in New England history than this slow moving, economic revolution which resulted in the break-up of land-community and the establishment of freehold land tenure for all classes. In studying the town records of Salem and Plymouth, one cannot fail to perceive that the undercurrent of New England town-life, however broken the surface, is one steady and unceasing drift of hard common sense, driven on by the resistless pressure of cumulating majorities and by the grinding force of public necessity.

MORRIS, G. S. Philosophy and Christianity. A Series of Lectures, delivered in New York [and repeated at the Johns Hopkins University], in 1883, on the Ely Foundation of the Union Theological Seminary. (*New York: Carter & Brothers. 329 pp., 12^{mo}. $1.75.*)

Religion and philosophy are held to be, or to involve, simply two different functions of one and the same intelligence, and with reference to the same objects of intelligence. "A religion," says Dr. Frantz Schultze (*Philosophie der Naturwissenschaft*, Leipzig, 1882, *Bd.* II, p. 418), "is a conception of the world, which has assumed the character of a universal popular philosophy (*Volksphilosophie*)." Or religion, on its intellectual side, is, at least in form and ideal, the immediate apprehension and assertion of final truths, which philosophy seeks reflectively to comprehend and to demonstrate. In particular, the thesis is reached and laid down, at the end of Lecture I, that "Philosophy and Christianity alike imply (1) a process of intelligence (Theory of Knowledge), by which (2) the absolute object of intelligence is reached (Theory or Science of Being)."

The attempt is then made to show—on the basis of a preliminary, summary statement of the "Philosophic Theory of Knowledge" and of the "Philosophic Theory of Reality" (Lectures II and III), and through a special examination of the "Biblical theory of Knowledge" (Lecture IV), and of "Biblical Ontology" with reference to God (Lecture V), the World (VI), and Man (VII)—that the fundamental ideal content of Christianity is "philosophic" (VIII), or that Christianity is "absolute religion."

LANIER, SIDNEY. The English Novel and the Principle of its Development. (*New York: Charles Scribner's Sons. 299 pp., 12^{mo}. $2.00.*)

This is a reproduction, in book form, of a course of public lectures delivered in the Johns Hopkins University in the winter and spring of 1881.

The leading line of thought is the continual development of the principle of personality, and its great expansion in modern times. That is to say, on the side of science, the personality of the individual is now minutely studied, instead of being kept in abeyance or disregarded altogether; and on the side of art, the artist, instead of following types, infuses more and more of personality—his own or another's—into his work. Although the movement in this direction has been continuous, yet the latter half of the seventeenth century may be conveniently taken as an epoch in its development, by the appearance of Bach, Newton, and Richardson, who may be regarded as the founders of modern music, modern science, and the modern novel.

Taking the novel, a story of life and character, as his more immediate theme, the author illustrates the grand impersonal Greek mode of treatment from the *Prometheus* of Aeschylus, where the actors are vast dim types of great powers or abstractions, and the interest centres in colossal action and suffering; then notes in passing the gradual increase of personality in later poets and prose writers, until its highest development is reached in the works of George Eliot, where portraiture is carried to the last refinement, and the individual, with his personal joys and sorrows, trials, failures, or triumphs, is everything.

ROWLAND, H. A. A Plea for Pure Science. (Address as Vice President of the Section of Physics of the American Association for the Advancement of Science, Minneapolis, August 15, 1883.)

This address is published in full in *Science*, August 24, 1883, also in the *Journal of the Franklin Institute*, *Nature*, the *Popular Science Monthly*, etc.

ELY, RICHARD T. French and German Socialism in Modern Times. (*New York: Harper & Brothers. 274 pp. 16^{mo}. 75 cents.*)

The aim of this work, as stated in the preface, is to give "a perfectly fair, impartial presentation of modern communism and socialism in their two strongholds, France and Germany." It was not at all the intention of the author to offer a critique of the various socialistic theories which he has sketched, inasmuch as economic literature abounds in refutations of communism and socialism. Newspapers and magazines circulate in every part of the country, which make continual warfare on all radical social reformers, but it is not so evident that they understand the men whom they combat. The service which the author hoped to render to society, was to expose the strength of its opponents, and this he believed it dangerous to underrate.

This book offers a series of sketches of the lives and doctrines of French and German communists and socialists from 1789 up to the present. Events are brought down to August, 1883.

The topics treated of are the following: The French Revolution and the Laboring Classes, Baboeuf, Cabet, Saint Simon, Fourier, Louis Blanc, Proudhon, Socialism in France since Proudhon, Rodbertus, Karl Marx, The International Workingmen's Association, Ferdinand Lassalle, The Ideal of Social Democracy, Social Democracy since the Death of Lassalle, Socialism of the Chair, Christian Socialism.

MARTIN, H. N. The Human Body. An Elementary Text-Book of Anatomy, Physiology, and Hygiene. (*New York: Henry Holt & Co. 355 pp. 8 . $1.50*)

"This elementary text-book of Physiology has been prepared in response to many requests for a text-book framed on the same plan as the "Human Body," but abridged for the use of students younger, or having less time to give to the subject, than those for whom that book was designed.

As a department of science, modern Physiology is controlled mainly by two leading generalizations—the doctrine of the "Conservation of Energy" and that of the "Physiological division of labor." I have endeavored in this, as in the larger book, to keep prominent these leading principles; and, so far as is possible in an elementary book, to exhibit the ascertained facts of Physiology as illustrations of or deductions from them.

Apart from the attempt to make elementary Physiology a more useful educational instrument than it has frequently hitherto been, the present volume differs from most others of its grade in having, as foot-notes or as appendices to the chapters, simple practical directions, assisting a teacher to demonstrate to his class certain fundamental things. The practical directions are, for the most part, reprints from a series of such which I drew up some years ago for a class composed of Baltimore teachers; those experiments which required costly apparatus have, of course, been omitted. The interest which my "Teacher's Class" took in its work, and the good use its members subsequently made of it, have encouraged me to believe that others might be glad of a few hints as to things suitable to show to young students of Physiology."—*Extract from Preface.*

PEABODY INSTITUTE. Catalogue of the Library of the Peabody Institute of the City of Baltimore, part I, A–C. (*Baltimore, 1883, 868 pp., 8°*).

Notice deferred.

HOPKINS HALL LECTURES.

Notice in Respect to the Admission of the Public.

In answer to inquiries, and in correction of some current misapprehensions, the following statements are made in respect to these courses of lectures annually given in the Johns Hopkins University.

1. These courses are academic lectures, designed primarily for the members of the University, and supplementary to the regular class-room work of the students.

2. As the members of the University rarely require the entire room, the Trustees have taken great pleasure in inviting other persons, not connected with the University, to attend.

3. As these lectures are not intended for popular entertainment, but for the instruction of students, those persons first receive tickets, in most cases, who are known to be especially interested in a particular course,—ladies as well as gentlemen. Preference is thus given according to the character of the course, to teachers in other institutions, public and private; students of medicine, law, etc.; professional men and others. If any tickets remain undistributed, they are given out to those who may have applied for them, in order of application.

4. The hall is full when 200 hearers are present; it is uncomfortable if more are admitted. Not infrequently two or three times that number of persons apply for admission, and often applications for tickets cannot be granted. To give the lectures elsewhere would alter their character as a part of the ordinary academic work of the University.

5. *There is no general course ticket issued.* Applications should state specifically the course for which tickets are desired. Programmes and other current information pertinent to university work may be found in the *University Circulars*, sent to subscribers on the payment of one dollar per annum, either by Messrs. Cushings & Bailey, Messrs. John Murphy & Co., or the University.

The usage of giving personal notification is not likely to be continued, and those therefore who have been accustomed to receiving such announcements, should hereafter consult the *Circulars*.

6. It will save much delay if applications for tickets and inquiries on these and other routine matters are addressed not to individuals but to the Johns Hopkins University, *by postal card*, and answers will be promptly returned by mail. Personal applications consume time needlessly.

☞The lectures begin at 5 o'clock *punctually*. The doors of the hall are opened at fifteen minutes before 5, and the lectures do not exceed an hour in the delivery.

PROGRAMME OF LECTURES, SESSION 1883-84.

I. HISTORY AND POLITICAL SCIENCE.

Dr. H. Von Holst, Professor in the University of Freiburg. Ten lectures, October 8–16.

The special subjects considered were the Relation of History and Politics, or of historical study and political speculations, with illustrations from the History and Politics of European States.

II. FRENCH LITERATURE.

M. Rabillon, Lecturer on French Literature, will give a course of seven lectures (*in French*) on *The Chanson de Roland*, beginning Thursday, November 1, and continuing on successive Thursdays, at *4 p. m.*, till December 13.

The following topics will be considered:—

I. Introduction. How the early Romance of France was a source of poetry for the nations of Europe until the Renaissance;—II. History of the Chanson de Roland;—III. The Treason of Ganelon;—IV. Roland's death;—V. The defeat of the French;—VI. The revenge;—VII. The punishment of the traitor, and conclusion.

III. MUNICIPAL HYGIENE.

Dr. John S. Billings, (Surgeon, United States Army), will give a course of twelve lectures on *Municipal Hygiene*, beginning Monday, November 5, and continuing on successive *Mondays and Wednesdays*, as follows:

1. Monday, November 5.—The growth of cities and their importance in modern civilization. Death rate in cities; Comparisons. The significance of death rates.
2. Wednesday, November 7.—The mortality rates of Baltimore. Life table for Baltimore. Mortality in different wards. Causes of disease.
3. Monday, November 12.—Causes of disease, continued. The Germ-theory and some of its applications.
4. Wednesday, November 14.—Water supply; impure water; water analysis; filtration; waste of water.
5. Monday, November 19.—Disposal of refuse, garbage, etc. Disposal of excreta. Cesspools; dry conservancy; sewerage.
6. Wednesday, November 21.—Systems of sewerage so-called; separate system; Waring system; Liernur system, etc.
7. Monday, November 26.—House drainage and plumbing as connected with municipal regulations.
8. Wednesday, November 28.—Streets, parks, and cemeteries.
9. Monday, December 3.—Schools and education.
10. Wednesday, December 5.—Food, markets, etc.
11. Monday, December 10.—Jurisprudence of hygiene; Management of contagious diseases; quarantine.
12. Wednesday, December 12.—Health Departments and Health Officers; duties and responsibilities; private sanitary organizations. Conclusion.

These lectures are designed first for students of the university, next for persons officially or for other reasons interested in sanitary science and the administration of cities, and then for the medical profession. The number of these persons is so large that the invitation cannot be extended to others.

IV. ROMAN LEGAL HISTORY.

James Bryce, Esq., M. P., D. C. L., Regius Professor of the Civil Law in the University of Oxford, will give a short course of lectures, *Introductory to the Study of Roman Legal History*, in Hopkins Hall, beginning Tuesday, November 20, at 5 p. m.

On account of the large number of students who are expected to attend this course it is not possible to extend a general invitation to the public.

V. CLASSICAL ARCHÆOLOGY.

Mr. Joseph Thacher Clarke, who has been in charge of the work of the Archæological Institute of America at Assos, will give three lectures on *Classical Archæology*, as follows:

1. Tuesday, December 11.—The rise of Archæology since the death of Winckelmann to its present position as a science.
2. Friday, December 14.—The results of the recent investigations at Assos, with particular reference to the unpublished work of the last two years.
3. Tuesday, December 18—Cyrene, and the Colonies of the Greeks in Northern Africa: the advantages presented by the Cyrenaica as a field for archæological researches.

Particulars in regard to the following courses will be given later.

The Fertilization of Flowers. Professor William Trelease, of the University of Wisconsin. Four lectures, in January.

English Literature. Professor Hiram Corson, of Cornell University. Twenty lectures, January 21 to March 7.

LIST OF OFFICERS AND STUDENTS, 1883-84.

Preliminary list of names and residences. The Annual Register of the University, containing the full list of names, etc., is published at the close) academic year).

TRUSTEES.

President.	Treasurer.	Secretary.
RGE W. Dobbin.	Francis White.	Lewis N. Hopkins.

George William Brown,
89 W. Chase St.

George W. Dobbin,
St. Denis P. O., Baltimore Co.

Joseph P. Elliott,
187 St. Paul St.

John W. Garrett,
77 W. Monument St.

Charles J. M. Gwinn,
35 Mt. Vernon Place.

Lewis N. Hopkins,
138 St. Paul St.

Francis T. King,
76 Cathedral St.

J. Hall Pleasants,
66 Mt. Vernon Place.

Alan P. Smith,
45 Franklin St.

C. Morton Stewart,
167 Dolphin St.

James Carey Thomas,
817 Madison Av.

Francis White,
237 St. Paul St.

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ACADEMIC STAFF.

EL C. Gilman, LL.D., *President of the University.* 81 Saratoga St.
ale College, 1852, and A. M., 1855; LL. D., Harvard University and St. John's College, 1876; sor in Yale College, 1863-72; President of the University of California, 1872-75.

L. Gildersleeve, Ph.D., LL.D., *Professor of Greek.*
253 St. Paul St.
rinceton College, 1849, and A. M., 1852; Ph. D., University of Göttingen, 1853; LL. D., e of William and Mary, 1869; Professor of Greek in the University of Virginia, 1856-76; sor of Latin in the University of Virginia, 1861-66; *Editor of the American Journal of Phil-*

Haupt, Ph.D., *Professor of the Shemitic Languages.*
163 St. Paul St.
Jniversity of Leipsic 1878; Professor of Assyriology in the University of Göttingen.

WELL Martin, Dr.Sc., A.M., *Professor of Biology, and Director of e Biological Laboratory.* 221 St. Paul St.
niversity of London, 1871, and Dr. Sc., 1872; A. B., University of Cambridge, 1874, and A. 77; late Fellow and Lecturer on Natural History in Christ College, Cambridge; Fellow of rsity College, London; M. D. (Hon.), University of Georgia, 1881; *Editor of Studies from the ical Laboratory.*

LES D. Morris, A.M., *Collegiate Professor of Latin and Greek.*
158 N. Howard St.
incoln College, Oxford, 1849, A. M., and Fellow of Oriel College, Oxford, 1852; Professor in iversity of New York, 1875-76.

EMSEN, M.D., Ph.D., *Professor of Chemistry, and Director of the hemical Laboratory.* 218 St. Paul St.
f the City of New York; M.D., College of Physicians and Surgeons, N. Y., 1867; Ph.D., Uni- of Göttingen, 1870; Professor of Chemistry in Williams College, 1872-76, and previously nt in Chemistry in the University of Tübingen; *Editor of the American Chemical Journal.*

Y A. Rowland, Ph.D., *Professor of Physics, and Director of the Physal Laboratory.* 14 Cathedral St.
nsselaer Polytechnic Institute, Troy, 1870; Assistant Professor in the same, 1872-75; Ph. D., Hopkins University, 1880.

Sylvester F. R. S., D. C. L., *Professor of Mathematics.*
St. James Hotel.
niversity of Cambridge; F. R. S., London and Edinburgh; Corresponding Member, Institute nce; Member, Academy of Sciences in Berlin, Göttingen, Naples, Milan, St. Petersburg, etc.; , University of Dublin, University of Edinburgh; D. C. L., University of Oxford; Honorary of St. John's College, Cambridge; late Professor of Mathematics in the Royal Military Acad- Voolwich; Copley Medalist, Royal Society, London, 1880; *Editor of the American Journal of natics.*

S. Billings, M. D., *Lecturer on Municipal Hygiene.*
tford (Ohio), 1857, and A. M., 1860; M. D., Cincinnati, 1860; Surgeon, U. S. Army, and Libra- the Surgeon General's Office.

Corson, A.M., LL.D., *Lecturer on English Literature.*
of Anglo-Saxon and English Literature in the Cornell University.

ANLEY Hall, Ph.D., *Lecturer on Psychology.*
lliams College, 1867, and A. M., 1870; Ph.D., Harvard University, 1878; Lecturer in Harvard illiams Colleges;

J. Rendel Harris, A.M., *Lecturer on New Testament Greek.*
Mosher and McCulloh Sts.
A. B., University of Cambridge, 1874, and A. M., 1877; Fellow, and late Lecturer and Librarian of Clare College, Cambridge.

H. Von Holst, Ph. D., *Lecturer on History.*
Professor in the University of Freiburg, Germany.

George S. Morris, A.M., Ph.D., *Lecturer on the History of Philosophy.*
132 W. Madison St.
A. B., Dartmouth College, 1861, and A. M., 1864; Ph. D., University of Michigan, 1881; Professor of Logic, Ethics, and the History of Philosophy in the University of Michigan.

Charles S. Peirce, A.M., S.B., *Lecturer on Logic.* 272 N. Calvert St.
A. B., Harvard University, 1859, A. M., and S. B., 1863; of the U. S. Coast and Geodetic Survey.

Léonce Rabillon, Bach. ès Lett., *Lecturer on French Literature.*
69 Park Av.
Bach. ès Lettres, Université de France, 1832, and Licencié en Droit, 1836.

Charles F. Raddatz, *Examiner in German.* 228 Argyle Av.
Professor in the Baltimore City College.

Herbert B. Adams, Ph.D., *Associate Professor of History.*
41 Cathedral St.
A. B., Amherst College, 1872; Ph. D., University of Heidelberg, 1876; *Editor of University Studies in Historical and Political Science.*

Maurice Bloomfield, Ph.D., *Associate Professor of Sanskrit.*
123 W. Madison St.
A. M., Furman University, 1877; Ph. D., Johns Hopkins University, 1879.

William K. Brooks, Ph.D., *Associate Professor of Morphology and Director of the Chesapeake Zoölogical Laboratory.* 75 Mt. Royal Av.
A. B., Williams College, 1870; Ph. D., Harvard University, 1875.

Thomas Craig, Ph. D., *Associate Professor of Applied Mathematics.*
12 First St.
C. E., Lafayette College, 1875; Ph. D., Johns Hopkins University, 1878.

Charles S. Hastings, Ph. D., *Associate Professor of Physics, Sub-Director of the Physical Laboratory, and Lecturer on Solar Physics.*
8 Denmead St.
Ph. B., Yale College, 1870, and Ph. D., 1873; Holder of the "Tyndall Scholarship" in Paris, 1875.

Harmon N. Morse, Ph.D., *Associate Professor of Chemistry and Sub-Director of the Chemical Laboratory.* 266 N. Howard St.
A. B., Amherst College, 1873; Ph. D., University of Göttingen, 1875; Instructor in Chemistry at Amherst College, 1875-76.

William E. Story, Ph. D., *Associate Professor of Mathematics.*
256 N. Calvert St.
A. B., Harvard University, 1871; Ph. D., University of Leipsic, 1875; Tutor of Mathematics at Harvard University, 1875-76.

Minton Warren, Ph. D., *Associate Professor of Latin.*
84 W. Monument St.
A. B., Tufts College, 1870; Ph. D., University of Strassburg, 1879.

William Hand Browne, M.D., *Librarian, and Examiner in English.*
2 Huntingdon Av.
M. D., University of Maryland, 1850.

A. Marshall Elliott, A. M., *Associate in Romance Languages.*
241 N. Calvert St.
A. B., Haverford College, 1866, and A. M., 1878; A. B., Harvard University, 1868.

Richard T. Ely, Ph. D., *Associate in Political Economy.* 288 Madison Av.
A. B., Columbia College, 1876, and A. M., 1879; Fellow of Columbia College, 1876-79; Ph. D., University of Heidelberg, 1879.

Fabian Franklin, Ph. D., *Associate in Mathematics.* 258 Linden Av.
Ph. B., Columbian University, 1869; Ph. D., Johns Hopkins University, 1880.

J. Franklin Jameson, Ph. D., *Associate in History.* 54 McCulloh St.
A. B., Amherst College, 1879; Ph. D., Johns Hopkins University, 1882.

Philip R. Uhler, *Associate in Natural History.* 218 W. Hoffman St.
Librarian of the Peabody Institute, and President of the Maryland Academy of Sciences.

George H. Williams, Ph. D., *Associate in Mineralogy.* 48 Cathedral St.
A. B., Amherst College, 1878; Ph. D., University of Heidelberg, 1882.

Henry Wood, Ph. D., *Associate in English.* 67 Oak St.
A. B., Haverford College, 1869; Ph. D., University of Leipsic, 1879.

G. Theodore Dippold, Ph. D., *Instructor in German.* 134 W. Madison St.
Ph. D., Boston University, 1883.

Edward M. Hartwell, M. D., Ph. D., *Instructor in Physical Culture.* 87 Park Av.
A. B., Amherst College, 1873, and A. M., 1876; Ph. D., Johns Hopkins University, 1881; M. D., Miami Medical College, 1882.

Hugh Newell, *Instructor in Drawing.* 58 Lexington St.

Charles L. Woodworth, Jr., *Instructor in Elocution.* 680 Madison Av.
Amherst College; Boston University School of Oratory, 1875.

Herbert W. Conn, A. B., *Assistant in Biology.* 125 Park Av.
A. B., Boston University, 1881.

H. H. Donaldson, A. B., *Assistant in Biology.* 148 St. Paul St.
A. B., Yale College, 1879.

Otto Lugger, *Assistant in Biology.* 429 N. Carey St.

Harry F. Reid, A. B., *Assistant in Physics.* 75 Mt. Vernon Place.
A. B., Johns Hopkins University, 1880.

Edward H. Spieker, Ph. D., *Assistant in Greek and Latin.* 128 N. Paca St.
A. B., Johns Hopkins University, 1879, and Ph. D., 1882.

Henry A. Todd, A. B., *Assistant in Romance Languages.* The Brexton.
A. B., Princeton College, 1876, Fellow and Tutor in Modern Languages in Princeton College, 1876-80.

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STUDENTS.

Fellows by Courtesy.

R. Dorsey Coale. Baltimore. 215 *Madison Av.*
Ph. D., Johns Hopkins University, 1881; Fellow in this University, 1880-81, and Assistant in the Chemical Laboratory, 1881-83; Lecturer on Chemistry in the University of Maryland. *Chemistry.*

William P. Durfee, Berkeley, Cal. 28 *McCulloh St.*
A. B., University of Michigan, 1876; Ph. D., Johns Hopkins University, 1883; Fellow of this University, 1881-83. *Mathematics.*

Adolph Gerber. Germany. 28 *McCulloh St.*
Ph. D., University of Munich, 1882. *Teutonic Languages.*

Henry R. Goodnow. Brooklyn, N. Y. 209 *N. Howard St.*
A. B., Amherst College, 1878; Fellow of this University, 1882-83. *Physics.*

Arthur L. Kimball. Plainfield, N. J. 186 *St. Paul St.*
A. B., Princeton College, 1881; Fellow in Science, Princeton College, 1881-2; Fellow of this University, 1882-83. *Physics.*

Thomas W. Mills. Montreal, Quebec. 164 *N. Eutaw St.*
A. B., University of Toronto, 1871, and A. M., 1872; M. D., McGill University, 1878; L. R. C. P. (Eng.); Demonstrator of Physiology and Histology at McGill University. *Biology.*

Henry L. Osborn. Madison, N. J. 266 *N. Howard St.*
A. B., Wesleyan University, 1878; Fellow of this University, 1881-82. *Biology.*

Henry N. Stokes. Moorestown, N. J. 24 *McCulloh St.*
S. B., Haverford College, 1878; Fellow of this University, 1881-83. *Chemistry.*

Henry A. Short. New York City. (A)
A. B., Columbia College, 1880; Fellow of Columbia College, 1880-83. *Greek.*

William C. Thayer. Geneva, N. Y. (A)
A. B., Columbia College, 1876; Professor in Hobart College, 1882-83. *Latin, etc.*

Albert L. Webster. Staten Island, N. Y. 87 *Park Av.*
Ph. B., Yale College, 1879; Topographer of U. S. Geological Survey, 1880-83. *Biology and Chemistry.*

Edmund B. Wilson. Geneva, Ill. (A)
Ph. B., Yale College, 1878; Ph. D., Johns Hopkins University, 1881; Fellow in this University, 1879-81; now studying in the Marine Laboratory at Naples under Dr. Dohrn. *Biology.*

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(A). Not now in attendance on the University.

Fellows.

William M. Arnolt. New Brunswick, N. J. 213 *W. Biddle*
Stuttgart Gymnasium, 1878; B. D., New Brunswick Theological Seminary, 1882. *Gree*

Gustav Bissing. Baltimore. 264 *W. Lombard*
A. B., Johns Hopkins University, 1882. *Mathematics.*

Adam T. Bruce. New York City. 128 *W. Madison*
A. B., Princeton College, 1881. *Biology.*

Archibald L. Daniels. Kendallville, Ind. 118 *W. Biddle*
A. B., University of Michigan, 1876. *Mathematics.*

Ellery W. Davis. Baltimore. 28 *McCulloh*
S. B., University of Wisconsin, 1879. *Mathematics.*

David T. Day. Baltimore. 266 *N. Howard*
A. B., Johns Hopkins University, 1881. *Chemistry.*

John Dewey. Burlington, Vt. 266 *N. Howard*
A. B., University of Vermont, 1879. *Philosophy.*

James R. Duggan. Macon, Ga. 330 *N. Eutaw*
A. B., Mercer University, 1877, and A. M., 1880; M. D., Jefferson Medical College, 1
Chemistry.

Alfred Emerson. Baltimore. 218 *N. Carrollton*
Ph. D., University of Munich, 1881. *Greek.*

Arthur L. Frothingham. Rome, Italy. 132 *W. Madison*
Ph. D., University of Leipsic, 1883. *Shemitic Languages.*

Elgin R. L. Gould. Oshawa, Ont. 52 *McCulloh*
A. B., Victoria University, 1881. *History.*

Arthur S. Hathaway. Decatur, Mich. 205 *N. Howard*
S. B., Cornell University, 1879. *Mathematics.*

William H. Howell. Baltimore. 433 *N. Mount*
A. B., Johns Hopkins University, 1881. *Biology.*

Hans C. G. von Jagemann. Naumburg, Germany. 209 *W. Biddle*
Naumburg Gymnasium, 1876. *Modern Languages.*

Edward H. Keiser. Allentown, Pa. 266 *N. Howard*
S. B., Swarthmore College, 1880, and S. M., 1881. *Chemistry.*

Gustav A. Liebig, Jr. Baltimore. 307 *St. Paul*
A. B., Johns Hopkins University, 1882. *Physics.*

C. W. Emil Miller. Baltimore. 806 *S. Sharp*
A. B., Johns Hopkins University, 1882. *Greek.*

Charles A. Perkins. Ware, Mass. 8 *McCulloh*
A. B., Williams College, 1879. *Physics.*

Lewis T. Stevens. Baltimore. 121 *Charles St.*
A. B., Johns Hopkins University, 1882. *Biology.*

Lewis W. Wilhelm. Baltimore. 11 *Edmondson*
A. B., Johns Hopkins University, 1880. *History.*

(2

Graduate Students.

John J. Abel. Cleveland, Ohio. 110 *Edmondson*
Ph. B., University of Michigan, 1883. *Biology and Chemistry.*

Cyrus Adler. Philadelphia, Pa. 352 *Linden*
A. B., University of Pennsylvania, 1883. *Shemitic Languages.*

Edmund K. Alden. Marshfield, Mass. 82 *Bolton*
A. B., Amherst College, 1880. *English, History, etc.*

Ethan A. Andrews. New York City. 182 *Madison*
Ph. B., Yale College, 1881. *Biology.*

William W. Baden. Baltimore. 51 *W. Fayette*
A. B., Johns Hopkins University, 1881. *Latin and Greek.*

William S. Bayley. Baltimore. 641 *W. Lombard*
A. B., Johns Hopkins University, 1883. *Chemistry and Mineralogy.*

Edward W. Bemis. Springfield, Mass. 40 *McCulloh*
A. B., Amherst College, 1880. *History.*

T. Alexis Berry. Baltimore. 247 *Bolton*
A. B., Johns Hopkins University, 1882. *History and Political Science.*

Henry G. Beyer. U. S. N. *The Albi*
M. D., Bellevue Hospital Medical College, 1876; M. R. C. S. (Eng.); Passed Assistant
geon, U. S. N. *Biology.*

Benjamin L. Bowen. Chili Station, N. Y. 48 *McCulloh*
A. B., University of Rochester, 1831. *Modern Languages.*

William S. Boyd, Jr. Kingstree, S. C. 120 *N. Green*
A. B., Davidson College, 1882. *Chemistry and Biology.*

Richard N. Brackett. Charleston, S. C. 266 *N. Howard*
A. B., Davidson College, 1883. *Chemistry.*

PAUL McD. BRICE.	Winnsboro, S. C.	266 *N. Howard St.*	A. B., Erskine College, 1883. *English and Political Science.*
JAMES D. BRUCE.	Charlotte Co., Va.	55 *Saratoga St.*	A. M., University of Virginia, 1883. *Chemistry.*
RICHARD E. BURTON.	Hartford, Conn.	132 *W. Madison St.*	A. B., Trinity College, 1883. *English.*
J. TEVIS COBB.	Richmond, Ky.	54 *McCulloh St.*	A. B., Central University (Ky.), 1879, and A. M., 1883. *Modern Languages.*
ALFRED D. CROWE.	Baltimore.	115 *W. Townsend St.*	A. B., Geneva College, 1874. *Languages.*
DAVIS R. DEWEY.	Burlington, Vt.	266 *N. Howard St.*	A. B., University of Vermont, 1879. *History and Political Science.*
THOMAS H. DINSMORE.	York, Pa.	*York, Pa.*	A. B., Highland University (Kansas), 1876, A. M., 1879, and Ph. D., 1883. *Chemistry, etc.*
THOMAS DIXON, JR.	Shelby, N. C.	111 *Charles St. Av.*	A. M., Wake Forest College, 1883. *History and Political Science.*
CHARLES S. DOLLEY.	Rochester, N. Y.	40 *McCulloh St.*	M. D., University of Pennsylvania, 1882. *Biology.*
FRANK DONALDSON, JR.	Baltimore.	108 *Park Av.*	A. B., Harvard University, 1879; M. D., University of Maryland, 1883. *Biology.*
LOUIS DUNCAN.	Baltimore.	10 *N. Carey St.*	U. S. Naval Academy, 1880. *Physics and Mathematics.*
CHARLES G. DUNLAP.	Chillicothe, Ohio.	36 *Boundary Av.*	A. B., Ohio Wesleyan University, 1883. *English.*
ALBERT E. EGGE.	Decorah, Iowa.	150 *N. Eutaw St.*	A. B., Norwegian Luther College, 1879. *English, German, etc.*
JULIAN O. ELLINGER.	Baltimore.	410 *Park Av.*	U. S. Naval Academy, 1883. *Physics and Mathematics.*
HERBERT C. ELMER.	Rushford, N. Y.	16 *McCulloh St.*	A. B., Cornell University, 1883. *Latin and Greek.*
WILLIAM H. EMERSON.	Tunnel Hill, Ga.	218 *Linden Av.*	U. S. Naval Academy, 1880. *Chemistry and Physics.*
GUSTAV A. EVENSON.	Iola, Wis.	150 *N. Eutaw St.*	A. B., Norwegian Luther College, 1880. *Teutonic Languages.*
JULIUS I. FAERBER.	Dorpat, Russia.	48 *McCulloh St.*	University of Dorpat, Russia. *Mathematics.*
JOHN A. FISHER.	Baltimore.	48 *W. Monument St.*	Ph.B., Illinois Wesleyan University, 1880. *History and Philosophy.*
JOSEPH A. FONTAINE.	Bué, France.	137 *N. Eutaw St.*	College of Nancy, France, 1879. *Romance Languages.*
ANDREW FOSSUM.	Elon, Iowa.	150 *N. Eutaw St.*	A. B., Norwegian Luther College, 1882. *Greek and History.*
LOUIS GARTHE.	Baltimore.	98 *Hill St.*	A. B., Johns Hopkins University, 1882. *Modern Languages.*
WILLIAM S. GRAVES.	Liberty, Va.	265 *Linden Av.*	A. M., Washington and Lee University, 1869, and B. L., 1872. *Greek and Latin.*
GEORGE B. HALDEMAN.	Cedarville, Ill.	16 *McCulloh St.*	A. B., Beloit College, 1883. *Biology.*
CLAYTON C. HALL.	Baltimore.	142 *Park Av.*	*Physics and Mathematics.*
ALBERT A. HANNA.	Baltimore.	231 *Maryland Av.*	M. D., University of Maryland, 1875. *Biology.*
HOMER W. HILLYER.	Waupun, Wis.	262 *W. Hoffman St.*	S. B., University of Wisconsin, 1882. *Chemistry.*
WILLIAM P. HOLCOMB.	Newtown, Pa.	266 *N. Howard St.*	B. L., Swarthmore College, 1878, and M. L., 1881. *History and Political Science.*
ANDREW HOLSTAD.	Decorah, Iowa.	172 *W. Biddle St.*	A. B., Norwegian Luther College, 1881. *Greek and Latin.*
EDWIN C. HOWELL.	Asbury Park, N. J.	*The Brexton.*	A. B., Harvard College, 1883. *Mathematics.*
ABEL H. HUIZINGA.	Zeeland, Mich.	213 *W. Biddle St.*	A. B., Hope College, 1880, and A. M., 1883. *Greek and Sanskrit.*
EDWARD INGLE.	Baltimore.	858 *Linden Av.*	A. B., Johns Hopkins University, 1882. *History.*
JOSEPH JASTROW.	Philadelphia, Pa.	256 *W. Lombard St.*	A. B., University of Pennsylvania, 1882. *Philosophy and Logic.*
HORACE F. JAYNE.	Philadelphia, Pa.	*St. James Hotel.*	A. B., University of Pennsylvania, 1879, and M. D., 1882. *Biology.*
GEORGE T. KEMP.	Baltimore.	55 *N. Green St.*	A. B., Johns Hopkins University, 1883. *Biology.*
JOHN H. KENNARD, JR.	New Orleans, La.	125 *Park Av.*	University of Louisiana, 1883. *History and Political Science.*
FREDERIC S. LEE.	Canton, N. Y.	266 *N. Howard St.*	A. B., St. Lawrence University (N.Y.), 1878, and A. M., 1881. *Biology.*
F. F. CARL LEHMANN.	Hamburg, Germany.	266 *N. Howard St.*	LL. D., University of Göttingen, 1883. *Shemitic Languages.*
CHARLES H. LEVERMORE.	New Haven, Conn.	263 *N. Howard St.*	A. B., Yale College, 1879. *History and Political Science.*
GONZALES LODGE.	Baltimore.	445 *N. Mount St.*	A. B., Johns Hopkins University, 1883. *Greek and Latin.*
CHARLES T. MCCLINTOCK.	Millersburg, Ky.	330 *N. Eutaw St.*	A. B., Kentucky Wesleyan College, 1881. *Biology and Chemistry.*
IRWIN P. MCCURDY.	Frederick.	*Frederick.*	B. E., Indiana (Pa.) State Normal School, 1876, and M. E., 1878; A. B., Lafayette College, 1880. *English.*
WILLIAM R. MCDANIEL.	St. Michaels.	38 *Mulberry St.*	A. B., Western Maryland College, 1880. *Mathematics, etc.*
JOSEPH S. MILLER.	York, Pa.	143 *Mulberry St.*	M. D., College of Physicians and Surgeons (Balto.), 1880. *Biology and Chemistry.*
PARK MORRILL.	Loudon, N. H.	47 *Courtland St.*	A. B., Amherst College, 1881; U. S. Signal Service. *Physics.*
HENRY F. NACHTRIEB.	St. Paul, Minn.	210 *Hoffman St.*	S. B., University of Minnesota, 1882. *Biology.*
JULIUS NELSON.	Waupaca, Wis.	225 *Druid Hill Av.*	S. B., University of Wisconsin, 1881. *Biology.*
HENRY B. NEWSON.	Mt. Gilead, Ohio.	266 *N. Howard St.*	S. B., Ohio Wesleyan University, 1883. *Chemistry and Physics.*
HENRY B. NIXON.	Winfall, N. C.	28 *McCulloh St.*	University of North Carolina, 1878. *Mathematics and Physics.*
WILLIAM H. OSBORNE.	Asheville, N. C.	142 *N. Charles St.*	A. M., Wake Forest College, 1883. *Greek and Latin.*
JOSEPH T. OUTEN.	Millersburg, Ky.	266 *N. Howard St.*	A. B., Ohio Wesleyan University, 1867, and A. M., 1870. *Mathematics and Physics.*
JAMES PAGE.	Baltimore.	81 *W. John St.*	A. B., Johns Hopkins University, 1882. *Physics.*
ALBERT G. PALMER.	Baltimore.	172 *McCulloh St.*	A. B., Johns Hopkins University, 1882. *Chemistry.*
ERNEST M. PEASE.	Boulder, Colo.	226 *Druid Hill Av.*	A. B., University of Colorado, 1882. *Latin.*
MANSFIELD T. PEED.	Petersburg, Va.	156 *N. Schroeder St.*	A. M., Randolph Macon College, 1878. *Physics and Mathematics.*
CAMERON PIGGOT.	Baltimore.	90 *N. Fulton St.*	M. D., University of Maryland, 1882. *Chemistry.*
ROBERT J. PRATT.	Albany, N. Y.	132 *W. Madison St.*	C. E., Rensselaer Polytechnic Institute, 1883. *Physics.*
B. JAMES RAMAGE.	Newberry, S. C.	52 *McCulloh St.*	A. B., Newberry College, 1880. *History.*
DANIEL R. RANDALL.	Annapolis.	365 *N. Charles St.*	A. B., St. John's College, 1883. *History and Political Science.*
EDSON P. RICH.	Brownville, Neb.	1 *McCulloh St.*	B. L., University of Nebraska, 1883. *History and Political Science.*
PERLEE L. RIEMAN.	Baltimore.	101 *W. Monument St.*	A. B., Princeton College, 1883. *Chemistry, Physics and Mathematics.*
LAWRASON RIGGS, JR.	Baltimore.	82 *Cathedral St.*	A. B., Princeton College, 1883. *History and Political Science.*
ADONIRAM J. ROBINSON.	Baltimore.	192 *Mulberry St.*	A. B., Johns Hopkins University, 1881. *Philosophy.*
EDWARD B. SANGER.	Rockville Centre, N.Y.	184 *N. Charles St.*	*Geology and Chemistry.*
SHOSUKI SATO.	Sapporo, Japan.	54 *McCulloh St.*	Sapporo Agricultural College (Japan), 1880. *History and Political Economy.*
WALTER B. SCAIFE.	Pittsburgh, Pa.	140 *Cathedral St.*	LL. B., University of Michigan, 1880. *History, etc.*
EDWARD M. SCHAEFFER.	Baltimore.	323 *Lexington St.*	M. D., University of Maryland, 1880. *Chemistry.*
LOUIS H. SCHUBART.	New York City.	178 *W. Lombard St.*	S. B., College of the City of New York, 1882. *Chemistry and Physics.*

Shadrach Simpson. A. B., Trinity College (N. C.), 1873, and A. M., 1875; Professor in Western Maryland College. *Chemistry.*	Westminster.	*Westminster.*
Albert Shaw. A. B., Iowa College, 1879, and A. M., 1882. *History and Political Science.*	Grinnell, Ia.	71 McCulloh St.
Moses Slaughter. A. B., Indiana Asbury University, 1883. *Latin and Greek.*	Brooklyn, Ind.	226 *Druid Hill Av.*
Evert B. Smedes. A. B., University of North Carolina, 1883. *Chemistry.*	Raleigh, N. C.	142 *N. Charles St.*
Preston Stamps. Ph. B., University of North Carolina, 1883. *Chemistry.*	Milton, N. C.	142 *N. Charles St.*
William B. Steel. A. B., Lafayette College, 1879, and A. M., 1882. *History and Political Science.*	Port Deposit.	258 *Linden Av.*
James E. Stout. University of Virginia, 1869. *Latin and Greek.*	Baltimore.	121 *Mulberry St.*
Henry Taber. Ph. B., Yale College, 1882. *Logic, etc.*	New York City.	190 *N. Calvert St.*
Bond V. Thomas. A. B., Haverford College, 1883. *History and Political Science.*	Baltimore.	817 *Madison Av.*
Albert H. Tolman. A. B., Williams College, 1877. *English.*	Pittsfield, Mass.	8 *McCulloh St.*
Charles D. Waller. A. B., Erskine College, 1883. *English and Political Science.*	Selma, Ala.	266 *N. Howard St.*
Clarence D. Warner. S. B., Mass. Agricultural College, 1881. *Mathematics and Physics.*	Granby, Mass.	57 *Bolton St.*
Frederick M. Warren, A. B., Amherst College, 1880. *Romance Philology and History.*	Durham, Maine.	82 *Bolton St.*
Henry C. Warren. A. B., Harvard University, 1879. *Sanskrit.*	Boston, Mass.	132 *W. Madison St.*
Henry V. Wilson. A. B., Johns Hopkins University, 1883. *Biology.*	Baltimore.	314 *Linden Av.*
Woodrow Wilson. A. B., Princeton College, 1879, and A. M., 1882. *History and Political Science.*	Wilmington, N. C.	146 N. Charles St.
Thomas K. Worthington. A. B., Haverford College, 1883. *History and Political Science.*	Baltimore.	209 *N. Howard St.*
Charles B. Wright. A. B., Buchtel College, (Ohio), 1880. *English.*	Akron, O.	8 *McCulloh St.*
Arthur Yager. A. B., Georgetown College, (Ky.), 1879. *History and Political Science.*	Georgetown, Ky.	268 *N. Howard St.*
Glossbrenner V. Yonce. A. B., Roanoke College, 1877, and A. M., 1882. *Chemistry.*	Lutherville.	*Lutherville.*
John H. Zweizig. A. B., Muhlenberg College, 1882. *Greek.*	Reading, Pa.	162 *Franklin St.*

(101)

Members of the Historical Seminary.

In addition to 27 elsewhere enrolled.

Edgar Goodman. A. B., Johns Hopkins University, 1880; LL. B., University of Maryland, 1881.	Baltimore.	814 *Hollins St.*
Edwin Hebden. Dickinson College.	Baltimore.	377 *N. Bond St.*
John Johnson. A. B., Johns Hopkins University, 1881.	Baltimore County.	*McDonogh P. O.*
John C. Rose. LL. B., University of Maryland, 1882.	Baltimore.	187 *N. Fremont St.*
Basil Sollers. Baltimore City College, 1871.	Baltimore.	279 *Mosher St.*

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Members of the Chesapeake Zoölogical Laboratory.

Session of 1883.

W. Bateson. St. John's College, University of Cambridge, Eng.	Cambridge, Eng.
Herbert W. Conn. A. B., Boston University, 1881.	Fitchburg, Mass.
J. E. Earle.	New York City.
Oliver P. Jenkins. A. B., Moore's Hill College, 1869, and A. M., 1872.	Moore's Hill, Ind.
Frederic S. Lee. Enrolled above.	Canton, N. Y.
J. Playfair McMurrich. Assistant in Biology, University of Toronto.	Toronto, Ont.
Thomas W. Mills. Enrolled above.	Montreal, Quebec.
Henry F. Nachtrieb. Enrolled above.	St. Paul, Minn.
Henry L. Osborn. Enrolled above.	Madison, N. J.
J. H. Pillsbury. Professor of Natural Science, Springfield, Mass.	Springfield, Mass.
Henry Sewall. Ph. D., Johns Hopkins University, 1879; Professor of Physiology, University of Michigan.	Ann Arbor, Mich.
William E. Stratton. A. B., Johns Hopkins University, 1883.	Baltimore.
Albert H. Tuttle. S. B., Pennsylvania State College, 1868; Professor of Zoölogy at Ohio State University.	Columbus, O.
Henry V. Wilson. Enrolled above.	Baltimore.
Francis Winslow. Lieut. U. S. N.; U. S. Fish Commission.	U. S. N.

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Matriculates.

Joseph S. Ames. Shattuck School.	Faribault, Minn.	215 *Druid Hill Av.*
Albert C. Applegarth. Baltimore City College.	Baltimore.	632 *W. Fayette St.*
C. Walter Artz. Mr. J. T. Carlile, Instructor.	Hagerstown.	73 *Edmondson Av.*
Richard H. Bayard. Mr. W. S. Marston's School.	Baltimore.	41 *Cathedral St.*
Thomas H. Buckler, Harvard College.	Baltimore.	135 *N. Charles St.*
John P. Campbell. Andrew Small Academy.	Charlestown, W. Va.	352 *N. Eutaw St.*
Walter B. Canfield. Mr. G. G. Carey's School.	Baltimore.	48 *Cathedral St.*
George G. Carey, Jr. Mr. G. G. Carey's School.	Baltimore.	265 *N. Eutaw St.*
William K. Cromwell. Mr. H. W. Luckett, Instructor.	Baltimore County.	94 *W. Lombard St.*
Charles W. R. Crum. Franklin and Marshall College.	Jefferson.	263 *N. Eutaw St.*
Eugene L. Crutchfield,* Mr. S. Z. Ammen, Instructor.	Baltimore.	(A)
William R. DeWitt.* McDonogh School.	Baltimore County.	*McDonogh P. O.*
Alfred R. L. Dohme.* Friends' High School.	Baltimore.	27 *Hollins St.*
William S. Eichelberger.* Baltimore City College, 1883.	Woodberry.	*Woodberry.*
Harry English.* Washington High School.	Washington, D. C.	*Washington, D. C.*
George B. Fadeley.* Mr. W. S. Marston's School.	Baltimore.	443 *W. Fayette St.*
James C. Fifield.* Phillips (Andover) Academy.	Kearney, Neb.	358 *N. Eutaw St.*
Harry Friedenwald. Baltimore City College.	Baltimore.	88 *N. Eutaw St.*
William E. Gates.* Mr. George Eastburn, Instructor.	Philadelphia, Pa.	79 *McCulloh St.*
Philip C. Gilbert.* Mr. G. G. Carey's School.	Glencoe.	*Glencoe.*
John Glenn, Jr. Mr. G. G. Carey's School.	Baltimore.	343 *N. Eutaw St.*

William L. Glenn. Mr. G. G. Carey's School.	Baltimore.	153 *N. Charles St.*
Basil B. Gordon. Mr. H. W. Luckett, Instructor.	Baltimore.	27 *Franklin St.*
William C. L. Gorton. Baltimore City College, 1883.	Baltimore.	88 *S. Ann St.*
Joseph E. Harry. Maryland Normal School.	Pylesville.	4 *McCulloh St.*
Benjamin H. Hartogensis. Baltimore City College, 1883.	Baltimore.	10 *Harrison St.*
John Hinkley. Mr. G. G. Carey's School.	Baltimore.	287 *N. Charles St.*
James S. Hodges.* St. Paul's School, Concord, N. H.	Baltimore.	83 *Saratoga St.*
Junius M. Horner.* University of Virginia.	Oxford, N. C.	54 *McCulloh St.*
Theodore Hough. Mr. W. S. Marston's School.	Baltimore.	181 *McCulloh St.*
Charles H. Howard. Mr. W. S. Marston's School.	Baltimore.	101 *N. Charles St.*
Robert C. Johnston. Mr. W. S. Marston's School.	Baltimore.	82 *Franklin St.*
Arthur L. Lamb.* Mr. E. M. Lamb, Instructor.	Baltimore.	187 *McCulloh St.*
James A. Loane. Baltimore City College, 1882.	Baltimore.	410 *N. Eden St.*
John D. Lord, Jr. Mr. M. A. Newell, Instructor.	Baltimore.	145 *Arlington Av.*
William P. Lyons. Loyola College.	Baltimore.	377 *N. Gilmor St.*
Allan McLane. Mr. H. W. Luckett, Instructor.	Baltimore.	87 *Cathedral St.*
Edgar G. Miller, Jr. Friends' Academy.	Baltimore.	279 *W. Baltimore St.*
William R. Orndorff. Baltimore City College, 1881.	Baltimore.	218 *Gilmor St.*
George D. Penniman. Baltimore City College.	Howard County.	*St. Denis P. O.*
William H. Perkins. Mr. W. S. Marston's School.	Baltimore.	207 *Franklin St.*
John Pleasants. Mr. W. S. Marston's School.	Baltimore.	66 *Mt. Vernon Place.*
Richard H. Pleasants.* Mr. H. W. Luckett, Instructor.	Baltimore.	40 *Cathedral St.*
Harry W. Price.* Baltimore City College, 1883.	Baltimore.	295 *Myrtle Av.*
Moses R. Ryttenberg.* Baltimore City College, 1882.	Baltimore.	72 *N. Front St.*
Hugo Steiner. Baltimore City College.	Baltimore.	23 *Hollins St.*
George C. Stokes, Jr. Dr. J. C. M. Mérillat, Instructor.	Govanstown.	*Govanstown.*
Frederick H. Wilkens. Friends' High School, 1882.	Baltimore.	266 *W. Lombard St.*
Langdon Williams.* Mr. W. S. Marston's School.	Boston, Mass.	74 *Cathedral St.*
William K. Williams.* Mr. W. S. Marston's School.	Boston, Mass.	74 *Cathedral St.*
Henry F. Wingert.* Washington County High School.	Hagerstown.	211 *W. Biddle St.*
Allan C. Woods. Mr. G. G. Carey's School.	Baltimore.	374 *Eutaw Pl.*

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*Conditionally.

NON-MATRICULATES.

Course Preliminary to the Study of Medicine

(Graduates and Matriculates pursuing this Course are enrolled above.)

William W. Donaldson. Princeton College.	Baltimore.	108 *Park Av.*
Jere W. Lord. Mr. M. A. Newell, Instructor.	Baltimore.	145 *Arlington Av.*
Elbert T. Riddick.* Baltimore City College.	Hertford, N. C.	172 *Linden Av.*
Audley H. Stow.* Baltimore City College.	Baltimore.	435 *N. Mount St.*
J. Tassey Waltemeyer.* Friends' High School.	Baltimore.	463 *N. Carey St.*
John R. Winslow. Friends' School, Providence, R. I.	Baltimore.	23 *McCulloh St.*

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*Conditionally

Special Students.

W. Lloyd Bevan, Rev. W. Kirkus, Instructor. *Languages.*	Baltimore.	101 *W. Lanvale St.*
Thomas L. Cole. Virginia Theological Seminary. *Hebrew and Greek.*	Baltimore.	65 *McCulloh St.*
Arthur T. Collins. Private Instruction. *Chemistry.*	Mt. Washington.	*Mt. Washington.*
J. Hill Dawson. Princeton College. *History and Political Science.*	Baltimore.	70 *W. Madison St.*
Albert A. Doub. Washington County High School. *History.*	Hagerstown.	268 *W. Fayette St.*
John L. Drain. E. Deichmann, Ph.D., Instructor. *History.*	Havana, Cuba.	1 *Pearl St.*
George W. Edmond. Amherst College. *Chemistry and Biology.*	Portland, Me.	266 *N. Howard St.*
James A. Fink. Holy Cross College, (Worcester, Mass.) *History.*	Baltimore.	221 *Franklin St*
Henry A. Frederick. Phillips Academy, Andover. *History.*	Douglass, Pa.	358 *N. Eutaw St.*
Jacob Grape, Jr. Baltimore City College, 1878.	Baltimore.	97 *Hillen St.*
John S. Hughes. Baltimore City College. *History and Political Science.*	Baltimore.	238 *Madison Av.*
Philip H. Friese. Instructor in Baltimore City College. *Philosophy, etc.*	Baltimore.	158 *N. Stricker St.*
John H. Laessig. Maryland College of Pharmacy. *Chemistry.*	Baltimore.	419 *W. Fayette St.*
William B. D. Penniman. Baltimore City College. *Physics.*	Howard County.	*St. Denis P. O.*
John H. Ramsburg. Private Instruction. *Chemistry and Physics.*	Frederick.	172 *W. Fayette St*
Benjamin T. Roberts, Jr. University of Rochester. *Latin, etc.*	North Chili, N. Y.	259 *Madison Av.*
David E. Roberts. Pennsylvania State College. *Chemistry.*	Baltimore.	7 *Tome St.*
Charles H. Shinn. University of California. *History and Political Science.*	San Francisco, Cal.	8 *McCulloh St.*
Henry R. Slack, Jr. Maryland College of Pharmacy. *Chemistry.*	La Grange, Ga.	82 *N. Green St.*
S. Tagart Steele. University of Virginia. *Biology.*	Baltimore.	92 *W. Madison St.*
Michael D. Stein. University of California. *Greek and Latin.*	Pittsburg, Pa.	144 *Park Av.*
James E. Talmage. Lehigh University. *Chemistry and Biology.*	Provo City, Utah.	147 *Eutaw St.*
William J. Thomas. Randolph-Macon. *History and Political Science.*	Baltimore.	10 *S. Calhoun St.*
Henry M. Thomas. Haverford College. *Biology.*	Baltimore.	317 *Madison Av.*

William Walz.	Baltimore.	288 *E. Madison St.*
Baltimore City College.	*Greek and Latin.*	
Henry H. Wiegand.	Baltimore.	272 *Madison Av.*
Baltimore City College.	*Chemistry.*	
Douglas M. Wylie.	Baltimore.	215 *Franklin St.*
Baltimore City College.	*History.*	

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SUMMARY.

ACADEMIC STAFF.

President and Professors,	8
Lecturers,	9
Associate Professors,	8
Associates,	8
Instructors and Assistants,	10
	43

ENROLLED STUDENTS.

Graduates (including Fellows),	148
Matriculates,	52
Non-Matriculates,	33
	233

The attendance upon the various courses of instruction as shown by the schedule of classes is as follows:

Mathematics,	35	German,	57
Physics,	55	Romance Languages,	30
Chemistry,	51	English,	46
Biology,	42	History and Political Science,	85
Greek,	36	Philosophy, Logic, etc.,	16
Latin,	36	Drawing,	30
Sanskrit, etc.,	15	Elocution,	42
Shemitic Languages,	9		

ENROLLED STUDENTS—1876-83.

	Graduates (including Fellows).	Matriculates.	Non-Matriculates.	Total Enrolled.	Average Attendance upon Public Lectures.
1876-77	54	12	23	89	60
1877-78	58	24	22	104	84
1878-79	68	25	35	128	96
1879-80	79	32	48	159	118
1880-81	102	37	37	176	186
1881-82	99	45	31	175	137
1882-83	125	49	30	204	148
1883-84*	148	52	33	233	—

* At the opening of the academic year.

Classification by Residences of Students.

Maryland, (Baltimore, 94),	115	Maine,	
New York,	17	Minnesota,	
Pennsylvania,	12	Nebraska,	
Massachusetts,	10	Vermont,	
North Carolina,	8	Alabama,	
New Jersey,	5	Colorado,	
Ohio,	5	Louisiana,	
Iowa,	4	New Hampshire,	
Kentucky,	4	Utah,	
South Carolina,	4	West Virginia,	
Georgia,	3		
Indiana,	3	Canada,	
Michigan,	3	Germany,	
Virginia,	3	Cuba,	
Wisconsin,	3	England,	
California,	2	France,	
Connecticut,	2	Italy,	
District of Columbia,	2	Japan,	
Illinois,	2	Russia,	

Students Enrolled above have been Graduated in the Institutions below named:

Johns Hopkins University,	25	University of Göttingen,	
University of Maryland,	6	Highland University, (Kansas),	
Amherst College,	5	Hope College, (Mich.)	
Princeton College,	5	Illinois Wesleyan University,	
University of Michigan,	4	Indiana Asbury University,	
Norwegian Luther College,	4	Iowa College,	
University of Pennsylvania,	4	Kentucky Wesleyan University,	
Yale College,	4	University of Leipsic,	
Harvard University,	3	University of Louisiana,	
Haverford College,	3	Massachusetts Agricultural College,	
University of North Carolina,	3	Mercer University,	
Ohio Wesleyan University,	3	University of Minnesota,	
U. S. Naval Academy,	3	McGill University,	
University of Wisconsin,	3	Moore's Hill College,	
Cornell University,	2	Muhlenberg College,	
Davidson College,	2	University of Nebraska	
Erskine College,	2	College of City of New York,	
Lafayette College,	2	Newberry College,	
University of Munich,	2	New Brunswick Theol. Seminary,	
Swarthmore College,	2	Pennsylvania State College,	
University of Vermont,	2	Randolph Macon College,	
University of Virginia,	2	Rensselaer Polytechnic Institute,	
Wake Forest College, (N. C.)	2	University of Rochester,	
Williams College,	2	St. John's College, (Md.)	
Beloit College,	1	St. Lawrence University,	
Boston University,	1	University of Toronto,	
Central University, (Ky.)	1	Trinity College, (Conn.)	
Bellevue Hospital Medical College,	1	Trinity College, (N. C.)	
Buchtel College, (Ohio),	1	Washington and Lee University,	
University of Cambridge, (England),	1	Wesleyan University, (Conn.)	
University of Colorado,	1	Victoria University, (Canada),	
Columbia College,	1	Western Maryland College,	
Geneva College, (Pa.)	1	College of Physicians and Surg. (Balto.	
Georgetown College, (Ky.)	1		

RECENT APPOINTMENTS.

Dr. Paul Haupt, Professor of Assyriology in the University of Göttingen, having accepted a call to the Johns Hopkins University as Professor of the Shemitic Languages, entered upon his duties in September. Nine students are now enrolled under his instruction. Classes are organized in Hebrew, Arabic, Assyrian, Ethiopic, and Sumero-Accadian. A special room has been set apart as a library and working room for those who are engaged in Oriental Studies under the direction of Dr. Haupt in the Shemitic tongue, and of Dr. Bloomfield in Sanskrit and the cognate languages.

The enlarged facilities of the BIOLOGICAL LABORATORY, and the call of Dr. Sedgwick to Boston after the announcements for the year were made, have caused several changes in the Biological staff, which, as organized for the current year, is as follows:

Director, H. N. Martin, Professor of Biology.

Director of the Chesapeake Zoological Laboratory, W. K. Brooks, Associate Professor of Biology.

Lecturer for the current year on Botany, Professor William Trelease, of the University of Wisconsin.

Lecturer on Psychology, Dr. G. Stanley Hall.

Assistants, H. H. Donaldson, H. W. Conn, and Otto Lugger.

The persons below named have been appointed by the University teachers of MODERN LANGUAGES:

German: G. Theodore Dippold, Ph. D., Boston University, 1883, late Instructor in the Boston University.

French: Henry A. Todd, A. B., Princeton College, 1876, Fellow and Tutor in Princeton College, 1876-80.

In addition to the facilities heretofore given, a conversational class has been formed German by Dr. Lehmann, and in French by Mr. Fontaine, under the guidance resp tively of Mr. Elliott and Dr. Wood.

The following promotions and appointments of gentlemen recently connected with t Johns Hopkins University have been reported at the office, viz.:

Edward Barnes, Graduate Student, 1882-83, *Professor of the Higher Mathematics in Rose Polytechnic Institute, Terre Haute, Indiana.*

William H. Carpenter, Fellow by Courtesy, 1881-83, *Instructor in the Scandinavi Languages in Columbia College.*

R. Dorsey Coale, Ph. D., 1881, Fellow and Assistant, 1880-83, *Lecturer on Chemistry the University of Maryland.*

William C. Day, A. B., 1880, Ph. D., 1883, Fellow, 1881-83, *Professor of Chemistry a Physics in St. John's College, Annapolis, Maryland.*

George S. Ely, Ph. D., 1883, Fellow, 1881-83, *Professor of Mathematics in Buchtel Colle Ohio.*

William S. Fleming, Fellow, 1882-83, *Professor of Greek and German in Davids College.*

Kakichi Mitsukuri, Ph. D., 1883, Fellow, 1880-81, *Professor of Zoology in the Univers of Tokio, Japan.*

William A. Noyes, Ph. D., 1882, *Professor of Chemistry in the University of Tennessee.*

Bernard F. O'Connor, Ph. D., 1883, Fellow, 1880-82, *Instructor in French in Columb College.*

William T. Sedgwick, Ph. D., 1881, Fellow, Assistant, and Associate in Biology, 1879- *Assistant Professor of Biology in the Massachusetts Institute of Technology.*

ENUMERATION OF CLASSES, FIRST HALF-YEAR, 1883–4.

Mathematics. (35 Students).

Classes meet in Rooms 8 and 16.

Algebra of Multiple Quantity: Professor Sylvester. Twice weekly, Tuesday and Friday, 4 p. m. (6).

Bissing.
Daniels.
Davis.
Durfee.
Hathaway.
Howell, E. C.

Mathematical Astronomy: Dr. Story. Three times weekly, Monday, Wednesday, and Friday, 12 m. (2).

Bissing.
Nixon.

Theory of Invariants: Dr. Story. Three times weekly, Monday, Wednesday, and Friday, 10 a. m. (6).

Bissing.
Daniels.
Davis.
Durfee.
Hathaway.
Howell, E. C.

Conic Sections: Dr. Story. Twice weekly, Tuesday and Thursday, 1 p. m. (14).

Ames.
De Witt.
Dohme.
Eichelberger.
Faerber.
Gilbert.
Gorton.
Haldeman.
Horner.
McDaniel.
Outen.
Peed.
Warner.
Wingert.

Higher Plane Curves: Dr. Story. Twice weekly, Tuesday and Thursday, 11 a. m. (2).

Faerber.
Nixon.

Theoretical Dynamics: Dr. Craig. Twice weekly, Tuesday and Thursday, 10 a. m. (5).

Daniels.
Davis.
Durfee.
Hathaway.
Nixon.

Mathematical Theory of Sound: Dr. Craig. Three times weekly, Monday, Wednesday, and Friday, 11 a. m. (5).

Bissing.
Duncan.
Liebig, G. A.
Perkins, C. A.
Reid.

Elliptic Functions: Dr. Craig. Three times weekly, Monday, Wednesday, and Friday, 1 p. m. (4).

Daniels.
Faerber.
Hathaway.
Nixon.

Mechanics: Dr. Franklin. Three times weekly, Tuesday, Thursday, and Friday, 10 a. m. (6).

Duncan.
Ellinger.
Hall.
Liebig, G. A.
Morrill.
Perkins, C. A.

Total Differential Equations: Dr. Franklin. Twice weekly, Tuesday and Thursday, 11 a. m. (6).

Crum.
Ellinger.
Peed.
Perkins, W. H.
Pratt.
Rieman.

Determinants and Theory of Equations: Dr. Franklin. Three times weekly, Monday, Wednesday, and Friday, 11 a. m. (9).

Crum.
De Witt.
Ellinger.
Faerber.
Hall.
Morrill.
Peed.
Pratt.
Warner.

Differential and Integral Calculus: Dr. Franklin. Three times weekly, Monday, Wednesday, and Friday, 1 p. m. (16).

Ames.
De Witt.
Dohme.
Eichelberger.
Gilbert.
Gorton.
Haldeman.
Hillyer.
Horner.
McDaniel.
Newson.
Outen.
Palmer, A. G.
Rieman.
Warner.
Wingert.

Physics. (55 Students).

Classes meet in Rooms 3, 4, 7, 8, 9.

Thermodynamics: Professor Rowland. Four times weekly, Monday, Tuesday, Thursday, and Friday, 9 a. m. (10).

Davis.
Duncan.
Durfee.
Ellinger.
Hathaway.
Kimball.
Liebig, G. A.
Morrill.
Perkins, C. A.
Reid.

Laboratory Work: Professor Rowland. Daily. (10 advanced students).

Duncan.
Ellinger.
Goodnow.
Kimball.
Liebig, G. A.
Morrill.
Perkins, C. A.
Pratt.
Reid.
Rieman.

Major Course: Dr. Hastings. Lecture, once weekly, Thursday, 4 p. m. Laboratory work daily, especially Tuesdays. (16).

Crum.
Day, D. T.
De Witt.
Ellinger.
Emerson, W. H.
Faerber.
Hall.
Hathaway.
Keiser.
Newson.
Nixon.
Peed.
Pratt.
Rieman.
Warner.
Webster.

General Physics: *Minor Course:* Dr. Hastings. Daily, 10 a. m. (30).

Ames.
Bayard.
Brackett.
Buckler.
Canfield.
Donaldson, W. W.
Eichelberger.
Fink.
Fadeley.
Gates.
Gorton.
Hartogensis.
Horner.
Laessig.
Lamb.
Lyons.
McDaniel.
Outen.
Penniman, G. D.
Penniman, W. B. D.
Perkins, W. H.
Pleasants, R. H.
Ramsburg.
Riddick.
Roberts, D. E.
Smedes.
Stamps.
Waltemeyer.
Winslow.
Woods.

Laboratory Work: (*Class in General Physics*): Dr. Hastings and Mr. Reid. (29).

Ames.
Brackett.
Buckler.
Canfield.
Donaldson, W. W.
Eichelberger.
Fink.
Fadeley.
Gates.
Gorton.
Hartogensis.
Horner.
Laessig.
Lamb.
Lyons.
McDaniel.
Outen.
Penniman, G. D.
Penniman, W. B. D.
Perkins, W. H.
Pleasants, R. H.
Ramsburg.
Riddick.
Roberts, D. E.
Smedes.
Stamps.
Waltemeyer.
Winslow.
Woods.

Chemistry. (51 Students).

Classes meet in the Chemical Laboratory.

Laboratory Work: Professor Remsen and Dr. Morse. Daily. (51).

Applegarth.
Bayley.
Boyd.
Brackett.
Bruce, J. D.
Campbell.
Canfield.
Coale.
Collins.
Day, D. T.
Dinsmore.
Duggan.
Edmond.
Emerson, W. H.
Gilbert.
Gordon.
Hartogensis.
Hillyer.
Hinkley.
Johnston, R. C.
Keiser.
Laessig.
McClintock.
Miller, E. G.
Miller, J. S.
Mills.
Newson.
Orndorff.
Palmer, A. G.
Piggot.
Pleasants, J.
Ramsburg.
Rieman.
Roberts, D. E.
Ryttenberg.
Sanger.
Schaeffer.
Schubart.
Simpson.
Slack.
Smedes.
Stamps.
Steiner.
Stevens.
Stokes, H. N.
Talmage.
Walz.
Webster.
Wiegand.
Wylie.
Yonce.

General Chemistry: Professor Remsen. Daily, except Friday, 9 a. m. (27).

Brackett.
Canfield.
Dinsmore.
Edmond.
Emerson, W. H.
Gilbert.
Gordon.
Hartogensis.
Hinkley.
Miller, E. G.
Miller, J. S.
Orndorff.
Pleasants, J.
Ramsburg.
Rieman.
Roberts, D. E.
Ryttenberg.
Sanger.
Schaeffer.
Slack.
Smedes.
Stamps.
Steiner.
Talmage.
Walz.
Webster.
Wylie.

Physical Chemistry and Chemical Philosophy: Professor Remsen. Lecture, once weekly, Friday, 9 a. m. (32).

Bayley.
Boyd.
Brackett.
Campbell.
Collins.
Day, D. T.
Duggan.
Edmond.
Emerson, W. H.
Gordon.
Hillyer.
Johnston, R. C.
Keiser.
Laessig.
Miller, J. S.
Mills.
Newson.
Orndorff.
Palmer, A. G.
Piggot.
Rieman.
Roberts, D. E.
Sanger.
Schaeffer.
Schubart.
Simpson.
Slack.
Smedes.
Stamps.
Stokes, H. N.
Talmage.
Webster.

Analytical Chemistry: Dr. Morse. Four times weekly, Monday, Tuesday, Wednesday, and Thursday, 9 a. m. (8).

Boyd.
Campbell.
Hillyer.
Johnston, R. C.
Laessig.
Mills.
Newson.
Schubart.

Mineralogy: DR. WILLIAMS. Lectures three times weekly, Monday, Wednesday, and Friday, 4 p. m., and practical work, Saturday 9 a. m. to 12 m. (9).

Bayley.
Collins.
Hillyer.
Newson.
Palmer, A. G.
Piggot.
Sanger.
Talmage.
Yonce.

Biology. (42 Students.)

Classes meet in the Biological Laboratory.

General Biology: PROFESSOR MARTIN. Three times weekly, Monday, Tuesday, and Thursday, 11 a. m. (19).

Abel.
Andrews.
Bruce, A. T.
Boyd.
Campbell.
Duggan.
Edmond.
Haldeman.
Hanna.
Jayne.
Johnston, R. C.
McClintock.
Miller, J. S.
Nelson.
Roberts, B. T.
Slack.
Steele, S. T.
Talmage.
Webster.

Animal Physiology and Histology: PROFESSOR MARTIN. Three times weekly, Monday, Wednesday, and Friday, 10 a. m. (12).

Abel.
Andrews.
Bruce, A. T.
Friedenwald.
Hanna.
Jayne.
Jastrow.
Kemp.
Lord, J. W.
McClintock.
Nelson.
Wilson, H. V.

Animal Morphology: DR. BROOKS. Twice weekly, Monday and Thursday, 9 a. m. (12).

Andrews.
Bruce, A. T.
Conn.
Howell, W. H.
Jayne.
Kemp.
Lee.
Mills.
Nachtrieb.
Nelson.
Osborn, H. L.
Stevens.

Mammalian Anatomy: MR. CONN. Twice weekly, Tuesday and Thursday, 10 a. m. (8).

Abel.
Andrews.
Friedenwald.
Kemp.
Lord, J. W.
McClintock.
Nelson.
Wilson, H. V.

Osteology: MR. CONN. Twice weekly, Wednesday and Friday, 11 a. m. (10).

Andrews.
Boyd.
Campbell.
Haldeman.
Johnston, R. C.
McClintock.
Miller, J. S.
Nelson.
Roberts, B. T.
Talmage.

Laboratory Work: PROFESSOR MARTIN, MR. DONALDSON, MR. CONN. Daily, 9 a. m. to 5 p. m. (31).

Abel.
Andrews.
Beyer.
Boyd.
Bruce, A. T.
Campbell.
Donaldson, F.
Duggan.
Edmond.
Friedenwald.
Haldeman.
Hanna.
Howell, W. H.
Jastrow.
Jayne.
Johnston, R. C.
Kemp.
Lee.
Lord, J. W.
McClintock.
Miller, J. S.
Mills.
Nachtrieb.
Nelson.
Osborn, H. L.
Roberts, B. T.
Steele, S. T.
Stevens.
Talmage.
Webster.
Wilson, H. V.

Marine Laboratory: DR. BROOKS. At Hampton, Va., during the summer months. (15).

Bateson.
Conn.
Earle.
Jenkins.
Lee.
McMurrich.
Mills.
Nachtrieb.
Osborn, H. L.
Pillsbury.
Sewall.
Stratton.
Tuttle.
Wilson, H. V.
Winslow.

Greek. (36 Students).

Classes meet in 181 N. Howard St.

Seminary: PROFESSOR GILDERSLEEVE. Twice weekly, Monday and Wednesday, 12 m. (13).

Arnolt.
Emerson, A.
Huizinga.
Lodge.
Miller, C. W. E.

Baden.
Elmer.
Glenn, J.
Graves.
Holstad.
Osborne, W. H.
Slaughter.
Stout.

Historiography: PROFESSOR GILDERSLEEVE. Weekly, Thursday, 12 m. (12).

Arnolt.
Baden.
Elmer.
Emerson, A.
Glenn, J.
Graves.
Holstad.
Huizinga.
Miller, C. W. E.
Osborne, W. H.
Slaughter.
Stout.

Composition and Translation: PROFESSOR GILDERSLEEVE. Twice weekly, Tuesday and Friday, 10 a. m. (10).

Arnolt.
Elmer.
Glenn, J.
Graves.
Holstad.
Huizinga.
Lodge.
Miller, C. W. E.
Slaughter.
Stout.

Thucydides, BK. VII: PROFESSOR C. D. MORRIS. Four weekly, Tuesday, Wednesday, Thursday, and Friday, 12 m.

Bevan.
Fink.
Fossum.
Glenn, J.
Howard.
Loane.
McLane.
Pease.
Roberts, B. T.
Slaughte
Walz.
Wilkens.

Homer: Iliad: PROFESSOR C. D. MORRIS. Weekly, Wedn 9 a. m. (6).

Alden.
Dunlap.
Egge.
Fossum.
Stein.
Tolman.

Lysias: DR. SPIEKER. Four times weekly, Tuesday, Wedn Thursday, and Friday, 11 a. m. (8).

Fossum.
Harry.
Hodges.
Horner.
Hough.
Stein.
Williams
Williams

New Testament Criticism: MR. HARRIS. Twice weekly, day and Thursday, 9 a. m. (5).

Bevan.
Dunlap.
Glenn, W. L.
James.
Stout.

Prose Composition:

Class A. PROFESSOR C. D. MORRIS. Weekly, Monday, 12 m.

Bevan.
Fink.
Fossum.
Glenn, J.
Howard.
Loane.
McLane.
Roberts, B. T.
Walz.
Wilkens

Class B. DR. SPIEKER. Weekly, Monday, 11 a. m. (8).

Fossum.
Harry.
Hodges.
Horner.
Hough.
Stein.
Williams
Williams

Classical Antiquities: DR. EMERSON. Twice weekly, T and Thursday, 4 p. m. (4).

Lodge.
Pease.
Slaughter.
Wilkens

Latin. (36 Students).

Classes meet in 181 N. Howard St.

Seminary: Terence: DR. WARREN. Twice weekly, Tuesd Friday, 11 a. m. (12).

Baden.
Elmer.
Graves.
Holstad.
Huizinga.
Lodge.
Miller, C. W. E.
Osborne, W. H.
Pease.
Slaughte
Stout.
Zweizig.

Palaeography: DR. WARREN. Weekly, Wednesday, 11 (10).

Elmer.
Graves.
Holstad.
Lodge.
Miller, C. W. E.
Osborne, W. H.
Pease.
Slaughter.
Stout.
Zweizig.

Aulus Gellius: DR. WARREN. Weekly, Thursday, 10 (10).

Elmer.
Glenn, J.
Graves.
McLane.
Pease.
Pleasants, J.
Roberts, B. T.
Slaughter.
Stout.
Walz.

Cicero and Pliny's Letters: DR. WARREN. Three times w Tuesday, Wednesday, and Friday, 10 a. m. (5).

Glenn, J.
McLane.
Pleasants, J.
Roberts, B. T.
Walz.

The meetings on Wednesday are devoted to reading Latin at sight.

Lucretius: PROFESSOR C. D. MORRIS. Four times weekly, day, Wednesday, Thursday, and Friday, 10 a. m. (4).

Bevan.
Loane.
Stein.
Wilkens.

The meetings on Wednesday are devoted to reading Latin at sight.

Livy: DR. SPIEKER. Four times weekly, Tuesday, Wedne Thursday, and Friday, 9 a. m. (15).

Doub.
English.
Fadeley.
Fifield, J. C.
Frederick.
Harry.
Hodges.
Hough.
Howard.
Pleasants, R. H.
Price.
Scaife.
Williams,
Williams,
Woods.

Prose Composition:

Class A: DR. WARREN. Weekly, Monday, 10 a. m. (5).

Glenn, J.
McLane.
Pleasants, J.
Roberts, B. T.
Walz.

Class B: PROFESSOR C. D. MORRIS. Weekly, Monday, 10 (4).

Bevan.
Loane.
Stein.
Wilkens.

Class C: Dr. Spieker. Weekly, Monday, 9 a. m. (15).
Doub. English. Fadeley. Fifield, J. C. Frederick. Harry. Hodges. Hough. Howard. Pleasants, R. H. Price. Scaife. Williams, L. Williams, W. K. Woods.

Shemitic Languages. Professor Haupt. (9 Students).

Assyriological Exercises. (For advanced Assyriologists, including reading at sight of bilingual texts). Two hours weekly, Saturday, 12–2 p. m. (1).
Lehmann.

Sumero-Accadian: Weekly, Monday, 2–4 p. m. (4).
Adler. Arnolt. Frothingham. Lehmann.

Assyrian: Twice weekly, Tuesday and Thursday, 3 p. m. (5).
Adler. Arnolt. Gaebelein. Frothingham. Lehmann.

Arabic: Weekly, Wednesday, 3 p. m. (5).
Adler. Arnolt. Cole. Huizinga. Lehmann.

Hebrew: Twice weekly, Tuesday and Thursday, 4 p. m. (8).
Adler. Arnolt. Cole. Frothingham. Grape. Harris. Huizinga. Lehmann.

Ethiopic: Weekly, Wednesday, 4 p. m. (6).
Adler. Arnolt. Frothingham. Gaebelein. Harris. Lehmann.

Sanskrit and the comparative grammar of the cognate languages. Dr. Bloomfield. (15 Students).

Classes meet in 187 N. Howard St.

Elementary Sanskrit: Twice weekly, Tuesday, 9 a. m.; Friday, 12 m. (4).
Adler. Huizinga. Jagemann. Tolman.

Advanced Sanskrit:

Çakuntala: Weekly, Saturday, 10 a. m. (3).
Spieker. Todd. Warren, H. C.

Kāuçika-Sūtra (from the Manuscripts): Weekly, Tuesday, 3 p. m. (1).
Warren, H. C.

Rig Veda: Weekly, Wednesday, 10 a. m. (4).
Lehmann. Spieker. Todd. Warren, H. C.

Pāli: Weekly, Thursday, 10 a. m. (1).
Warren, H. C.

Comparative Philology: Weekly, Monday, 4 p. m. (13).
Adler. Arnolt. Burton. Egge. Evenson. Holstad. Huizinga. Jagemann. Lehmann. Spieker. Tolman. Wilkens. Wright.

German. (57 Students.)

Middle High German: Dr. Dippold. Twice weekly, Monday and Thursday, 9 a. m. (3).
Egge. Gates. Wright.

Stilübungen and Syntax: Mr. Raddatz. Second Wednesday of each month, 2.30 p. m. (5).
Dohme. Egge. Friedenwald. Gates. Glenn, J.

Beast Epic and Middle Low German: Dr. Gerber. Weekly, Wednesday, 4 p. m. (5).
Egge. Evenson. Emerson, A. Tolman. Wright.

German Literature (*Lectures in German*)**:** Dr. Dippold. Alternate Saturdays, 10 a. m. (11).
Artz. Bowen. Cromwell. De Witt. Dohme. Egge. Gates. Loane. Miller, E. G. Tolman. Wright.

(*Major Course*).

Goethe: Faust: Dr. Dippold. Twice weekly, Tuesday and Friday, 10 a. m. (9).
Artz. Alden. Cobb. Cromwell. DeWitt. Dohme. Miller, E. G. Tolman. Wright.

Lessing: Nathan d. Weise: Dr. Dippold. Twice weekly, Monday and Wednesday, 10 a. m. (6).
Artz. Cromwell. De Witt. Dohme. Graves. Miller, E. G.

Prose Composition: Mr. Raddatz. Weekly, Thursday, 2.30 p. m. (11).
Artz. Cromwell. De Witt. Dohme. Friedenwald. Gates. Glenn, J. Miller, E. G. Perkins, W. H. Tolman. Wright.

(*Minor Course.*)

Schiller: Maria Stuart: Dr. Dippold. Twice weekly, Tuesday and Thursday, 11 a. m. (22).
Ames. Burton. Cobb. Donaldson, W.W. Doub. English. Fadeley. Fifield, J. C Fink. Gilbert. Hartogensis. Lord, J. D. Lyons. McDaniel. Penniman, W.B.D. Ramage. Riddick. Stow. Waltemeyer. Winslow. Wiegand. Wingert.

Goethe: Egmont: Dr. Dippold. Twice weekly, Wednesday and Friday, 11 a. m. (20).
Ames. Donaldson, W.W. Doub. English. Fadeley. Fifield, J. C. Fink. Gilbert. Hartogensis. Lord, J. D. Lyons. McDaniel. Penniman, W.B.D. Riddick. Smedes. Stow. Waltemeyer. Winslow. Wiegand. Wingert.

Prose Composition: Mr. Raddatz. Weekly, Friday, 2.30 p. m. (24).
Ames. Cobb. Donaldson, W.W. Doub. Eichelberger. Ellinger. English. Fifield, J. C. Fink. Gilbert. Gorton. Hartogensis. Johnston, R. C. Lord, J. D. Lyons. McDaniel. Penniman, W.B.D. Price. Riddick. Slaughter. Stow. Waltemeyer. Wiegand. Winslow.

Minor Course: *Second Section:* Dr. Dippold. Thrice weekly, Monday, Wednesday, and Thursday, 2.30 p. m. (15).
Brackett. Brice. Buckler. Burton. Cobb. Doub. Dunlap. English. Lamb. Newson. Outen. Sato. Slaughter. Waller. Williams, W. K.

Classes for German Conversation meet twice weekly, Wednesday and Saturday, 9 a. m.

Romance Languages. (30 Students).

Classes meet in 111 W. Monument St.

Advanced Courses: *Provençal: Anglo Norman: Old French: Portuguese:* Mr. Elliott. (4 classes.) Four times weekly, Monday, Tuesday, Wednesday, and Thursday, 10 a. m. (5).
Bowen. Fontaine. Jagemann. Osborne, W.H. Warren, F. M.

Advanced Courses: *Spanish and Portuguese Dialects: Comparative Grammar of Romance Languages: Ladinian:* Mr. Elliott. (8 classes.) Three times weekly, Tuesday, Wednesday, and Thursday, 11 a. m. (5).
Bowen. Fontaine. Jagemann. Todd. Warren, F. M.

French Philology, Phonetics, etc.: Mr. Elliott. Weekly, Monday, 9 a. m. (8).
Bevan. Bowen. Fink. Fontaine. Lyons. Osborne, W. H. Warren, F. M. Wiegand.

Italian: Mr. Todd. Three times weekly, Monday, Tuesday, and Wednesday, 9 a. m. (9).
Bowen. Fink. Fontaine. Kemp. Lyons. Perkins, W. H. Warren, F. M. Wiegand. Wilkens.

Spanish: Mr. Todd. Twice weekly, Thursday and Friday, 9 a. m. (8).
Arnolt. Bowen. Kemp. Lord, J. D. Lord, J. W. Perkins, W.H. Warren, F. M. Wilkens.

French: Major Course: Mr. Todd. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 1 p. m. (6).
Bevan. Drain. Fink. Lyons. Osborne, W.H. Wiegand.

French: Minor Course: Mr. Todd. Daily, 12 m. (18).

Adler.
Carey.
Conn.
Drain.
Egge.
Fifield, J. C.
Hinkley.
Johnston, R. C.
Laessig.
Lord, J. D.
Penniman, W. B. D.
Pleasants, R. H.
Stow.

One exercise weekly of both the Major and Minor Courses is devoted to Prose Composition. Classes for French Conversation also meet daily.

English. (46 Students.)

Classes meet in 111 W. Monument St.

Old Saxon: *Heliand:* Dr. Wood. Weekly, Thursday, 12 m. (4).

Egge.
Evenson.
Tolman.
Wright.

Anglo-Saxon: Advanced Course: *Béowulf:* Dr. Wood. Twice weekly, Monday and Wednesday, 10 a. m. (5).

Crum.
Egge.
Evenson.
Tolman.
Wright.

(*Major Course*).

Anglo-Saxon: *Sweet's Reader:* Dr. Wood. Twice weekly, Monday and Wednesday, 12 m. (8).

Alden.
Brice.
Burton.
Cobb.
Dunlap.
Gates.
Stein.
Waller.

Early English: 1300-1400 *A. D.: Morris and Skeat's Specimens, Part* II.: Dr. Wood. Twice weekly, Tuesday and Friday, 12 m. (8).

Alden.
Brice.
Burton.
Cobb.
Dunlap.
Egge.
Gates.
Waller.

(*Minor Course*).

English Phonetics: Dr. Wood. Weekly, Monday, 11 a. m. (10).

Alden.
Brice.
Burton.
Cobb.
Cromwell.
Dunlap.
Gates.
Tolman.
Waller.
Wilkens.

Early English: *Chaucer:* Dr. Wood. Weekly, Wednesday, 11 a. m. (10).

Alden.
Brice.
Burton.
Cobb.
Cromwell.
Dunlap.
Gates.
Stein.
Waller.
Wilkens.

Shakespeare: *Hamlet:* Dr. Browne. Twice weekly, Tuesday and Thursday, 11 a. m. (9).

Alden.
Brice.
Burton.
Cobb.
Cromwell.
Dunlap.
Gates.
Waller.
Wilkens.

Grammatical and Rhetorical Exercises: Dr. Wood. Weekly, Friday, 11 a. m. (10).

Brice.
Burton.
Cobb.
Cromwell.
Egge.
Fisher.
Gates.
Stein.
Waller.
Wilkens.

English Literature: (*P. H. E. Course*): Dr. Browne. Twice weekly, Wednesday and Thursday, 12 m. (31).

Ames.
Bayard.
Buckler.
Cromwell.
Doub.
Dohme.
Donaldson, W. W.
Eichelberger.
English.
Fadeley.
Fifield, J. C.
Frederick.
Friedenwald.
Gorton.
Harry.
Hodges.
Horner.
Hough.
Howard.
Lamb.
McDaniel.
Orndorff.
Price.
Pleasants, R. H.
Riddick.
Waltemeyer.
Williams, L.
Williams, W. K.
Winslow.
Woods.
Wylie.

History and Political Science. (85 Students).

Seminary: Dr. Adams. Weekly, Friday, 8-10 p. m., in Bluntschli Library. (32).

Alden.
Bemis.
Berry.
Dewey, D. R.
Dewey, J.
Dixon.
Fisher.
Goodman.
Gould.
Holcomb.
Hebden.
Ingle.
Johnson, J.
Kennard.
Levermore.
Ramage.
Randall.
Rich.
Riggs.
Rose.
Sato.
Scaife.
Shaw.
Shinn.
Sollers.
Steel, W. B.
Thomas, B. T.
Warren, F. M.
Wilhelm.
Wilson, W.
Worthington.
Yager.

American History: Dr. Adams. Weekly, Thursday, 12 m. in Bluntschli Library. (27).

Alden.
Bemis.
Berry.
Dewey, D. R.
Dixon.
Fisher.
Gould.
Holcomb.
Ingle.
Kennard.
Levermore.
Ramage.
Randall.
Rich.
Riggs.
Sato.
Scaife.
Shaw.
Shinn.
Steel, W. B.
Thomas, B. T.
Thomas, W. J.
Warren, F. M.
Wilhelm.
Wilson, W.
Worthington.
Yager.

Church History: Dr. Adams. Twice weekly, Monday and Tuesday, 11 a. m., in Room 9. (22).

Alden.
Applegarth.
Artz.
Bayard.
Dawson.
Dewey, D. R.
Drain.
Fisher.
Fossum.
Glenn, J.
Glenn, W. L.
Holcomb.
James.
McLane.
Randall.
Riggs.
Ryttenberg.
Steiner.
Steel, W. B.
Thomas, B. T.
Warren, F. M.
Worthington.

International Law: Dr. Adams. Three times weekly, Monday Tuesday, and Wednesday, 12 m., in Bluntschli Library. (26).

Artz.
Berry.
Dewey, D. R.
Dewey, J.
Dixon.
Drain.
Gould.
Holcomb.
Ingle.
James.
Kennard.
Levermore.
Lyons.
Ramage.
Randall.
Rich.
Sato.
Scaife.
Shaw.
Shinn.
Steel, W. B.
Thomas, B. T.
Wilhelm.
Wilson, W.
Worthington.
Yager.

Political Economy: *Advanced Course:* Dr. Ely. Three time weekly, Monday, Wednesday, and Friday, 4 p. m., in Bluntschl Library. (25).

Bemis.
Berry.
Brice.
Dewey, D. R.
Dixon.
Gould.
Holcomb.
Ingle.
Kennard.
Levermore.
Ramage.
Randall.
Rich.
Riggs.
Sato.
Shaw.
Shinn.
Steel, W. B.
Thomas, B. T.
Thomas, W. J.
Waller.
Wilhelm.
Wilson, W.
Worthington.
Yager.

English Constitutional History: *Stubbs' Select Charters:* Dr Jameson. Weekly, Friday, 12 m., in Room 9. (10).

Artz.
Dewey, D. R.
Levermore.
Lyons.
Randall.
Scaife.
Thomas, B. T.
Wilson, W.
Worthington.
Yager.

English and French History: Dr. Jameson. Three time weekly, Wednesday, Thursday, and Friday, 11 a. m., in Room 9. (12)

Applegarth.
Artz.
Bayard.
Dawson.
Drain.
Glenn, W. L.
Howard.
McLane.
Randall.
Riggs.
Ryttenberg.
Steiner.

Political Economy: *Undergraduate Course:* Dr. Ely. Daily 1 p. m., in Room 9. (18).

Applegarth.
Artz.
Brice.
Carey.
Dawson.
Drain.
Glenn, W. L.
Hinkley.
Holcomb.
Howard.
Hughes.
Kennard.
Lord, J. W.
Miller, E. G.
Penniman, G. D
Price.
Riggs.
Scaife.

Introductory Historical Lectures: (*P. H. E. Course*): Dr Adams. Weekly, Friday, 12 m., in Room B, 111 W. Monument St (34).

Ames.
Bayard.
Buckler.
Dohme.
Donaldson, W. W.
Doub.
Eichelberger.
English.
Fadeley.
Fisher.
Friedenwald.
Gorton.
Harry.
Hartogensis.
Hodges.
Holcomb.
Horner.
Hough.
Hughes.
Lamb.
McDaniel.
Orndorff.
Pleasants, R. H.
Price.
Riddick.
Steel, W. B.
Stein.
Waltemeyer.
Williams, L.
Williams, W. K
Wingert.
Winslow.
Woods.
Wylie.

Greek and Roman History: (*P. H. E. Course*): Dr. Jameson Twice weekly, Monday and Tuesday, 12 m., in Room B, 111 W Monument St. (31).

Ames.
Bayard.
Buckler.
Dohme.
Donaldson, W. W.
Doub.
Eichelberger.
English.
Fadeley.
Frederick.
Friedenwald.
Gorton.
Harry.
Hartogensis.
Hodges.
Horner.
Hough.
Hughes.
Lamb.
McDaniel.
Orndorff.
Pleasants, R. H.
Price.
Riddick.
Waltemeyer.
Williams, L.
Williams, W. K
Wingert.
Winslow.
Woods.
Wylie.

ory of Philosophy, Logic, etc. (16 Students).

Classes meet in 187 N. Howard St.

inary (*Spinoza's Ethic*) **:** PROFESSOR G. S. MORRIS. Twice ekly, Tuesday and Thursday, 12 m. (5).

wey, J.
sher.
Jastrow.
Ryttenberg.
Steiner.

tory of German Philosophy: PROFESSOR G. S. MORRIS. ree times weekly, Monday, Wednesday, and Friday, 4 p. m. (8).

rton.
wey, J.
Fisher.
Friese.
Jastrow.
Osborn, H. L.
Ryttenburg.
Steiner.

tory of Philosophy: PROFESSOR G. S. MORRIS. Twice ekly, Tuesday and Thursday, 4 p. m. (8).

sher.
Friese.
Kemp.

ic (*Advanced Course*) **:** MR. PEIRCE. Twice weekly, Tuesday and iday, 9 a. m. (4.)

wey, J.
Jastrow.
Miller, C. W. E.
Taber.

losophical Terminology: MR. PEIRCE. Lectures weekly, ursday, 4 p. m. (2).

wey, J.
Jastrow.

ic (*Elementary Course*) **:** MR. HARRIS. Daily, 1 p. m. (8).

mpbell.
iedenwald.
Kemp.
Loane.
Lord, J. W.
Orndorff.
Ryttenberg.
Steiner.

hology, etc. DR. G. STANLEY HALL.

Classes to be formed in the second half-year.

Drawing. (80 Students).

MR. NEWELL. Daily, except Wednesday, 1 to 5 p. m.

(*Free-Hand Drawing*).

Andrews.
Campbell.
Carey.
Dohme.
English.
Fadeley.
Glenn, J.
Glenn, W. L.
Haldeman.
Hartogensis.
Hillyer.
Howell, W. H.
Johnston, R. C.
Laessig.
Lee.
Nelson.
Osborn, H. L.
Penniman, G. D.
Perkins, W. H.
Pleasants, J.
Riddick.
Stein.
Thomas, B. T.
Winslow.
Waltemeyer.

(*Mechanical Drawing*).

Bissing.
Crum.
Eichelberger.
Gorton.
McDaniel.

Elocution. (42 Students).

MR. WOODWORTH. Daily, 10 a. m. to 1 p. m.

Artz.
Bayard.
Bevan.
Bemis.
Bowen.
Canfield.
Cobb.
Crowe.
Dewey, J.
Dixon.
Dohme.
Doub.
English.
Fifield, J. C.
Fink.
Fisher.
Frederick.
Frothingham.
Gerber, A.
Glenn, W. L.
Harry.
Kennard.
Lee.
Loane.
Lodge.
Lyons.
Orndorff.
Osborn, H. L.
Pease.
Penniman, G. D.
Perkins, W. H.
Pleasants, J.
Price.
Roberts, B. T.
Scaife.
Slaughter.
Stein.
Tolman.
Waller.
Wiegand.
Williams, L.
Williams, W. K.

Physical Culture. DR. HARTWELL. Daily.

Classes will meet as hereafter announced.

APPOINTMENTS OF SOCIETIES.

tific Association.

essor Sylvester, President. Meets on the first Wednesday of each month in Hopkins Hall, 8 p. m.

rical and Political Science Association.

H. B. Adams, Secretary. Meets weekly, Friday, in Bluntschli Library, 8 p. m.

ematical Society.

essor Sylvester, President. Meets on the third Wednesday of each month in room 16, 8 p. m.

physical Society.

essor G. S. Morris, President. Meets on the second Tuesday of each month in 187 N. Howard Street, 8 p. m.

logical Association.

essor Gildersleeve, President. Meets on the first Friday of each month in Bentley Hall, 12 m.

The NATURALISTS' FIELD CLUB meets as announced from time to time.

The SOCIETY for the study of ENGLISH PHILOLOGY meets alternate MONDAYS, at 8 p. m.

The SOCIETY for the study of SHEMITIC PHILOLOGY meets weekly, SATURDAY, at 8.30 p. m.

The CLUBS for READING the SCIENTIFIC JOURNALS meet as follows:

In Physics, weekly, Wednesday, 9 a. m.; *In Biology*, weekly, Wednesday, 9 a. m.; *In Chemistry*, as announced.

Meeting of the MARYLAND HISTORICAL SOCIETY, second Monday of each month, 8 p. m., corner of Saratoga and St. Paul Sts.,

Meeting of the MARYLAND ACADEMY OF SCIENCES, first and third Mondays of each month, 8 p. m., corner of Saratoga and St. Paul Sts.

CONSULTATION HOURS.

(Unless otherwise indicated the rooms designated are in the University Buildings, corner of Howard and Ross Streets.)

rder to promote economy of time, on the part of students as well ers, brief consultations may be had with the gentlemen below- at the hours and places indicated. In case prolonged conference is le, special appointments may be made, by notes exchanged at the ar's office, or otherwise. The person named will usually be accesor some minutes after the appointed hour. The appointments do clude Saturday.

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ents are requested to call at the hours named, unless there are excepreasons for coming at some other time.

N, D. C.	*President's Office.*	1 p. m.
, H. B.	*Bluntschli Library.*	9 a. m.
FIELD, M.	123 *W. Madison St.*	12 m.
s, W. K.	*Biological Laboratory.*	11 a. m.
NE W. H.	*Library.*	9 a. m to 5 p. m.
. T.	*Room* 13	12 m.
R. T.	*Bluntschli Library.*	1 p. m.
TT, A. M.	111 *W. Monument St.*	12 m.
KLIN, F.	*Room* 13.	12 m.
RSLEEVE, B. L.	181 *Howard St.*	11 a. m.
s, J. R.	187 *Howard St.*	9 a. m.
WELL, E. M.	*Registrar's Office.*	9 a. m.
NGS, C. S.	*Room* 8.	11 a. m.
r, P.	113 *W. Monument St.*	(except Monday.) 5 p. m.
JAMESON, J. F.	*Bluntschli Library.*	12 m.
MARTIN, H. N.	*Biological Laboratory.*	12 m.
MORRIS, C. D.	181 *Howard St.*	11 a. m.
MORRIS, G. S.	187 *Howard St.*	1 p. m.
MORSE, H. N.	*Chemical Laboratory.*	2 p. m.
NEWELL, H.	*Room* 19.	(except Wed.) 1 p. m.
PEIRCE, C. S.	187 *Howard St.*	(Tues. and Fri.) 9 a. m.
RABILLON, L.	*Room* 8.	12 m.
REMSEN, I.	*Chemical Laboratory.*	11 a. m.
ROWLAND, H. A.	*Physical Laboratory.*	10 a. m.
SPIEKER, E. H.	181 *Howard St.*	10 a. m.
STORY, W. E.	*Room* 15.	(As posted at room) 11 a. m. and 12 m.
SYLVESTER, J. J.	*Room* 17.	8 p. m.
TODD, H. A.	111 *W. Monument St.*	12 m.
WARREN, M.	84 *W. Monument St.*	2 p. m.
WILLIAMS, G. H.	*Chemical Laboratory.*	9 a. m.
WOOD, H.	111 *W. Monument St.*	11 a. m.
WOODWORTH, C. L.	*Hopkins Hall.*	9 a. m. to 12 m.

Treasurer's and Registrar's Offices.

These offices are open daily, except Saturdays, from 9 a. m. to 6 p. m., and on Saturdays from 9 a. m. to 3 p. m., and from 4 to 4 30 p. m.

The Janitor, when not about the building, may be found at 111 W. Monument St.

HOURS FOR LECTURES AND RECITATIONS, FIRST HALF-YEAR, 1883-84.

HOURS.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
A. M. 9	General Chemistry. (Remsen.) Latin Prose. (Spieker.) Italian. (Todd.) Morphology. (Brooks.) Thermodynamics. (Rowland.) Analyt. Chemistry. (Morse.) French Philology. (Elliott.) Middle High German. (Dippold.)	General Chemistry. (Remsen.) Livy. (Spieker.) Italian. (Todd.) Thermodynamics. (Rowland.) Analyt. Chemistry. (Morse.) New Test. Criticism. (Harris.) Logic. (Peirce.) Elem. Sanskrit. (Bloomfield.)	General Chemistry. (Remsen.) Livy. (Spieker.) Italian. (Todd.) Analyt. Chemistry. (Morse.) Homer. (C. D. Morris.) German Conversation.	General Chemistry. (Remsen.) Livy. (Spieker.) Spanish. (Todd.) Morphology. (Brooks.) Thermodynamics. (Rowland.) Analyt. Chemistry. (Morse.) New Test. Criticism. (Harris.) Middle High German. (Dippold.)	Physical Chemistry. (Remsen.) Livy. (Spieker.) Spanish. (Todd.) Thermodynamics. (Rowland.) Logic. (Peirce.)	Mineralogy. (Williams.) German Conversation.
10	General Physics. (Hastings.) German: Major. (Dippold.) Physiology and Histol. (Martin.) Latin Prose. (Warren.) Latin Prose. (C. D. Morris.) Invariants. (Story.) Provençal. (Elliott.) Anglo-Saxon, Adv. (Wood.) Elocution. (Woodworth.)	General Physics. (Hastings.) German: Major. (Dippold.) Mammalian Anatomy. (Conn.) Greek Comp. (Gildersleeve.) Cicero and Pliny Letters. (Warren.) Lucretius. (C. D. Morris.) Anglo-Norman. (Elliott.) Mechanics. (Franklin.) Theoretical Dynamics. (Craig.) Elocution. (Woodworth.)	General Physics. (Hastings.) German: Major. (Dippold.) Physiol. and Histol. (Martin.) Latin: Read. at sight. (C.D.Morris.) Latin: Read. at sight. (Warren.) Invariants. (Story.) Old French. (Elliott.) Anglo-Saxon, Adv. (Wood.) Rig Veda. (Bloomfield.) Elocution. (Woodworth.)	General Physics. (Hastings.) Mammalian Anatomy. (Conn.) Aulus Gellius. (Warren.) Lucretius. (C. D. Morris.) Portuguese. (Elliott.) Mechanics. (Franklin.) Pali. (Bloomfield.) Theoretical Dynamics. (Craig.) Elocution. (Woodworth.)	General Physics. (Hastings.) German: Major. (Dippold.) Physiol. and Histology. (Martin.) Greek Comp. (Gildersleeve.) Cicero and Pliny Letters. (Warren.) Lucretius. (C. D. Morris.) Invariants. (Story.) Mechanics. (Franklin.) Elocution. (Woodworth.)	German Literature. (Lectures in German.) (Fortnightly.) Mineralogy. (Williams.) Çakuntala. (Bloomfield.)
11	General Biology. (Martin.) English: Minor. (Wood.) Greek Prose. (Spieker.) History: 2d year. (Adams.) Deter. and Theory of Equations. (Franklin.) Math. Theory of Sound. (Craig.) French Conversation. Elocution. (Woodworth.)	General Biology. (Martin.) German: Minor. (Dippold.) English: Minor. (Browne.) Lysias. (Spieker.) History: 2d year. (Adams.) Higher Plane Curves. (Story.) Latin Seminary. (Warren.) Spanish and Portuguese. (Elliott.) Total Diff. Equations. (Franklin.) French Conversation. Elocution. (Woodworth.)	Osteology. (Conn.) German: Minor. (Dippold.) English: Minor. (Wood.) Lysias. (Spieker.) History: 2d year. (Jameson.) Palaeography. (Warren.) Romance Languages. (Elliott.) Deter. and Theory of Equations. (Franklin.) Math. Theory of Sound. (Craig.) Elocution. (Woodworth.)	General Biology. (Martin.) German: Minor. (Dippold.) English: Minor. (Browne.) Lysias. (Spieker.) History: 2d year. (Jameson.) Higher Plane Curves. (Story.) Ladinian. (Elliott.) Total Diff. Equations. (Franklin.) French Conversation. Elocution. (Woodworth.)	Osteology. (Conn.) German: Minor. (Dippold.) English: Minor. (Wood.) Lysias. (Spieker.) History: 2d year. (Jameson.) Latin Seminary. (Warren.) Deter. and Theory of Equations. (Franklin.) Math. Theory of Sound. (Craig.) French Conversation. Elocution. (Woodworth.)	Mineralogy. (Williams.) Çakuntala. (Bloomfield.) French Conversation.
M. 12	French: Minor. (Todd.) English: Major. (Wood.) Greek Prose. (C. D. Morris.) P. H. E. (Jameson.) International Law. (Adams.) Greek Seminary. (Gildersleeve.) Math. Astronomy. (Story.) Elocution. (Woodworth.)	French: Minor. (Todd.) English: Major. (Wood.) Thucydides. (C. D. Morris.) P. H. E. (Jameson.) International Law. (Adams.) Philosophical Sem. (G.S. Morris.) Elocution. (Woodworth.)	French: Minor. (Todd.) English: Major. (Wood.) Thucydides. (C. D. Morris.) P. H. E. (Browne.) International Law. (Adams.) Greek Seminary. (Gildersleeve.) Math. Astronomy. (Story.) Elocution. (Woodworth.)	French: Minor. (Todd.) Old Saxon. (Wood.) Thucydides. (C. D. Morris.) P. H. E. (Browne.) Am. Colonial History. (Adams.) Greek Historiog. (Gildersleeve.) Philosophical Sem. (G. S Morris.) Elocution. (Woodworth.)	French: Minor. (Todd.) English: Major. (Wood.) Thucydides. (C. D. Morris.) P. H. E. (Adams.) English Constitution. (Jameson.) Math. Astronomy. (Story.) Elem. Sanskrit. (Bloomfield.) Elocution. (Woodworth.)	Assyriological Exercises. (Haupt.)
P. M. 1	L. E. P. (Harris.) Polit. Econ.: Undergrad. (Ely.) Calculus. (Franklin.) Drawing. (Newell.) Elliptic Functions. (Craig.)	L. E. P. (Harris.) French: Major. (Todd.) Polit. Econ.: Undergrad. (Ely.) Conic Sections. (Story.) Drawing. (Newell.)	L. E. P. (Harris.) French Major. (Todd.) Polit. Econ: Undergrad. (Ely.) Calculus. (Franklin.) Elliptic Functions. (Craig.)	L. E. P. (Harris.) French: Major. (Todd.) Polit Econ.: Undergrad. (Ely.) Conic Sections. (Story.) Drawing. (Newell.)	L. E. P. (Harris.) French: Major. (Todd.) Polit. Econ.: Undergrad. (Ely.) Calculus. (Franklin.) Drawing. (Newell.) Elliptic Functions. (Craig.)	Assyriological Exercises. (Haupt.) Drawing. (Newell.)
2	Sumero-Accadian. (Haupt.) German. (Dippold.) (2.30 p. m.) Drawing. (Newell.)	Drawing. (Newell.)	Stilübungen. (Raddatz.) (2.30 p. m.) 2d Wednesday. German. (Dippold.) (2.30 p. m.) French Conversation.	German Prose: Major. (Raddatz.) (2.30 p. m.) German. (Dippold.) (2.30 p. m.) Drawing. (Newell.)	German Prose: Minor. (Raddatz.) (2.30 p. m.) Drawing. (Newell.)	Drawing. (Newell.)
3	Sumero-Accadian. (Haupt.) Drawing. (Newell.)	Assyrian. (Haupt.) Kaucika-Sutra. (Bloomfield.) Drawing. (Newell.)	Arabic. (Haupt.)	Assyrian. (Haupt.) Drawing. (Newell.)	Drawing. (Newell.)	Drawing. (Newell.)
4	Political Economy: Adv. (Ely.) German Philos. (G. S. Morris.) Mineralogy. (Williams.) Comp. Philology. (Bloomfield.) Drawing. (Newell.)	Multiple Algebra. (Sylvester.) Hist. of Philos. (G. S. Morris.) Hebrew. (Haupt.) Class. Antiquities. (Emerson.) Drawing. (Newell.)	Political Economy: Adv. (Ely.) German Philos. (G. S. Morris.) Ethiopic. (Haupt.) Mineralogy. (Williams.) German. (Gerber.)	Physics: Major. (Hastings.) Hist. of Philos. (G. S. Morris.) Hebrew. (Haupt.) Philos. Terminology. (Peirce.) Class. Antiquities. (Emerson.) Drawing. (Newell.)	Multiple Algebra. (Sylvester.) Political Economy: Adv. (Ely.) German Philos. (G. S. Morris.) Mineralogy. (Williams.) Assembly of matriculated students. Drawing. (Newell.)	Drawing. (Newell.)

The hour from 5 to 6 p. m. is reserved for public lectures, as announced from time to time.

November, 1883.

ASTOR LI
Jan 184

JOHNS HOPKINS UNIVERSITY CIRCULARS

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CALENDAR, 1883–84.

uesday, September 18.	**Current Academic Year Began.**
uesday, September 25.	**Instructions Resumed.**
ecember 22.—January 2.	**Christmas Recess.**
riday, February 22.	**Commemoration Day.**
riday, April 11.—Monday, April 14.	**Spring Recess.**
riday, June 7.	**Term of Instruction Closes.**

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- On Involutants and other Allied Species of Invariants to Matrix Systems. By **J. J. Sylvester**, - 84
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$$\sum_0^k \frac{k!}{r!\,(k-r)!}\,|xy|^r X_y^{k-r}\,Y_x^{k-r}\,|XY|^r,$$

[compare with the operator in (1)].

But this is a function of Π itself, for we have

$$\Pi\,\Pi^{k-1}_{y\ \text{const.}} = \Pi^{k}_{y\ \text{const.}} + (k-1)\Pi^{k-1}_{y\ \text{const.}},$$

since Π alters the function of y, $\Pi^{k-1}_{y\ \text{const.}}$, (which is homogeneous in y of the degree $(k-1)$) only by the factor $(k-1)(0+1) = k-1$

$$\therefore\ \Pi^{k}_{y\ \text{const.}} = \Big\{\Pi-(k-1)\Big\}\,\Pi^{k-1}_{y\ \text{const.}}$$

$$= \Big\{\Pi-(k-1)\Big\}\Big\{\Pi-(k-2)\Big\}\Big\{\Pi-(k-3)\Big\}\ldots\Pi,$$

$$(\equiv \Pi^{k)}\ \text{say})$$

$$\therefore\ \Pi^{k}_{y\ \text{const.}} f = \Pi^{k)} f = [n(m+1)]^{k)} f,$$

or

$$f = \frac{\Pi^{k}_{y\ \text{const.}}}{[n(m+1)]^{k)}}\,f,$$

which must be (1) since it is easy to show there is but one such equation to a given value of k. The constants a_0, a_1, . . . , are thus not only completely determined, but the operator in (1) is transformed into a function of X_x, Y_y, namely $\equiv \dfrac{\big\{Y_y(X_x+1)\big\}^{k)}}{\big\{n(m+1)\big\}^{k)}}$.

CHEMISTRY.

Concerning the Existence of a Third Form of Oxygen. By Professor Remsen.

[Abstract of a communication to the University Scientific Association, November 7, 1883].

In a paper published last year in the *American Chemical Journal*, Vol. IV, p. 454, some experiments which had been performed by Mr. E. H. Keiser and the speaker were described, the results of which showed that air in the presence of moist phosphorus has not the power to oxidize carbon monoxide. Leeds and Baumann in earlier experiments had come to exactly the opposite conclusion. As neither ordinary oxygen nor ozone has the power to oxidize carbon monoxide, Baumann further concluded that when air comes in contact with moist phosphorus the oxygen is changed to active oxygen distinct from ozone. The paper above referred to has called forth replies from Leeds (*Chemical News*, Vol. 48, p. 25,) and from Baumann (*Berichte der deutschen chemischen Gesellschaft*, 16, p. 2146,) in which the respective authors describe new experiments and claim that these only confirm their first conclusion. As the work of Mr. Keiser and the speaker had been carried on with all possible precautions against error, and the paper embodying the result obtained had been published only after reflection, it did not seem probable that a repetition of the work would lead to different results. Nevertheless the very positive statements of Baumann, and the fact that his method of experimenting as described in his last paper is quite different from that described in his first, and different in some respects also from Mr. Keiser's, made a repetition appear desirable.

The feature in Baumann's latest experiments which first attracted attention, is the very large volume of air which he now finds necessary to conduct over the phosphorus before he gets evidence of oxidation. In his first paper (*Zeitschrift für physiologische Chemie*, 5, 251,) the description indicates that the oxidation is very easily effected. He says that the baryta water into which the gases were conducted, after having been brought in contact with the moist phosphorus, became turbid in a short time, and that *in the course of an hour there was formed an abundant precipitate* (reichlicher Niederschlag). Now, however, having taken the precautions suggested by Mr. Keiser and the speaker, avoiding the use of corks and rubber connectors, his result is quite different. Instead of getting an abundant precipitate in the course of an hour, he says that *after the first two hours there was a distinct turbidity* in the baryta water, and that in *ten hours more* the escape tube in which the precipitate was principally formed was stopped up. In another experiment he used a mixture of 700 c. c. carbon monoxide very much diluted with air, so that its passage through the apparatus required *fifteen hours;* and in another the passage of a mixture consisting of 30 litres of air which contained 2.45 litres carbon monoxide was continued for twelve hours. The quantity of carbon dioxide obtained in one experiment was .0366 gram, in another .064 gram.

In repeating the earlier experiments Mr. Keiser has obtained exactly the same results as before—that is, no evidence of oxidation could be obtained. On continuing the passage of the mixture of carbon monoxide and air over the phosphorus for several hours, so that volumes of the gases varying from 15 to 30 litres were used, the formation of a small precipitate in the baryta water was observed. A parallel experiment was now made with air alone, from which, of course, all carbon dioxide had been removed. After passing 15 litres through the apparatus, the formation of a slight precipitate was observed, and this increased, seeming to be formed in the same quantity in the case of air alone as in that of air and carbon monoxide. The apparatus used was so constructed as to completely prevent contact of the gases with all organic substances. Whence then came the carbon dioxide? Thinking it possible that it might come from organic matter in the air which had passed through the three wash bottles containing caustic soda and baryta water, and then been oxidized by the ozone formed in the presence of the phosphorus, a final precaution was taken for the purpose of avoiding this possible source of error.

The air used was first passed over heated copper oxide, placed in a hard glass tube on a combustion furnace, and then through wash bottles to remove all traces of carbon dioxide, care being taken to avoid all contact with rubber and cork. This air, passed over moist phosphorus and then washed by passage through water, gave the same precipitate in baryta water as that used in the preceding experiments. The precipitate was carefully examined for the presence of phosphorus compounds but not a trace of them could be found. It could have been nothing but barium carbonate. Acids liberated a gas, and the whole conduct of the substance was that of a carbonate.

The only possible source of the carbon dioxide is the phosphorus, and it hence follows that the phosphorus used by us certainly contained carbon in some form. As the air slowly burns up the phosphorus, the carbon is also slowly converted into carbon dioxide. The amount of the precipitate should then vary with the amount of phosphorus exposed and the temperature. Some experiments since performed show clearly that this relation exists. Without going into further details in this place, it may be stated that as the result of a large number of experiments, it can be stated with certainty that ordinary phosphorus contains a small quantity of carbon, probably in chemical combination, and that it is to the presence of this carbon that the small precipitate obtained by Baumann is due. Efforts have been made to remove the carbon from some specimens of phosphorus, but without success.

The experiment as described by Leeds certainly does cause the formation of a precipitate, but the same precipitate is formed if air alone be placed in the vessel.

It will be seen that the conduct of moist phosphorus towards a mixture of air and carbon monoxide furnishes no evidence of the existence of a third form of oxygen.

A paper containing a detailed description of the experiments together with drawings of the apparatus used will soon be published in the *American Chemical Journal.*

Oxidation of β-Cymenesulphamide. By Professor Remsen and W. C. Day.

[Abstract of a paper in the *American Chemical Journal*, Vol. V, p. 149].

The experiments described in this and the following papers form a continuation of an investigation which has been in progress in this laboratory for the past seven years. The object in view is the determination of the law governing the conduct of a large class of substitution products towards oxidizing agents. It has been shown in the earlier papers of the series that when, in aromatic hydrocarbons, the marsh gas group bears a certain relation to an acid group, its oxidation by chromic acid is prevented, while in the two other possible positions it is not protected, but apparently conducts itself just as if the acid group were not present. The first experiments referred only to the simplest marsh gas group, viz., methyl CH_3. It was subsequently shown by Remsen and Noyes that under the same conditions the larger group ethyl, C_2H_5, is just as completely pro-

Johns Hopkins University Circulars.

BALTIMORE, JANUARY, 1884.

CURRENT INTELLIGENCE.

ıe University Circulars are intended to include notes of progress
e work of the Johns Hopkins University as a whole, and in the
ıl laboratories, seminaries, and associations which are directed by
rincipal teachers. They are not designed to be a magazine for long
es. The University contributes liberally to the maintenance of six
als devoted to the study of Mathematics, Chemistry, Biology, Physi-
, Philology, and History—and there are many other publications
is country through which extended memoirs may reach the public.
r these circumstances it is deemed best by the authorities to reserve
pages for official announcements, and for concise statements respecting
·ches which have here been made in the different branches of science
iterature. There is ample space for such communications.

Departure of Professor Sylvester.

ɔfessor Sylvester, who has been the Professor of Mathematics in this
ersity since its opening in 1876, has left Baltimore to take the chair
vilian Professor of Geometry in the University of Oxford, to which
as elected December 5, 1883. A farewell assembly of gentlemen
ladies was held in Hopkins Hall December 20, when addresses
made by the President of the University, Judge Brown, Professor
rsleeve, and Professor Sylvester. Among the guests were Mr.
hew Arnold, Professor Newcomb, Professor Asaph Hall, Professor
ırd, of Washington, Mr. Scudder, the Editor of *Science*, and other
guished persons from a distance, besides a large number of the liter-
scientific, and professional men of Baltimore. Before the addresses
ı pertained to the departure of Professor Sylvester, Mr. Matthew
ld (who had at an earlier hour given a public lecture in the Academy
usic), was presented to the assembly, with a complimentary allusion
former connection with the University of Oxford, and to the fact
Professor Sylvester had dedicated to him the "Laws of Verse," pub-
l in 1870. Mr. Arnold made a friendly response. Mr. Sylvester's
rks were full of pleasant allusions to his work at the Johns Hop-
his esteem for his colleagues, and his good wishes for the foundation.
ıddress was not written and occupied nearly an hour in delivery.

Ɔn the afternoon of December 20, the academic staff of the Univer-
ıet in Hopkins Hall, by invitation of the President, and after a brief
w by Dr. Story of the mathematical lectures here given from 1876
33, and a like review by Dr. Craig of the contributions printed in
lmerican Journal of Mathematics, Professor Gildersleeve read the
ring paper, which, on motion of Professor Rowland, was adopted
e meeting as an expression of their respect and good will.

'he teachers of the Johns Hopkins University, in bidding farewell
ɔir illustrious colleague, Professor Sylvester, desire to give united
ssion to their appreciation of the eminent services he has rendered
Jniversity from the beginning of its actual work. To the new
ation he brought the assured renown of one of the great mathemati-
ımes of our day, and by his presence alone made Baltimore a great
of mathematical research.

o the work of his own department he brought an energy and a
ion that have quickened and informed mathematical study not only
nerica, but all over the world; to the workers of the University,
ıer within his own field or without, the example of reverent love
ıth and of knowledge for its own sake, the example of a life conse-
l to the highest intellectual aims. To the presence, the work, the
ple of such a master as Professor Sylvester, the teachers of the Johns
ins University all owe, each in his own measure, guidance, help,
ation, and in grateful recognition of all that he has done for them
hrough them for the University, they wish for him a long and happy continuance of his work in his native land; for themselves the power of transmitting to others that reverence for the ideal which he has done so much to make the dominant characteristic of this University."

— The Savilian Professorship of Geometry in the University of Oxford, was founded and endowed in the year 1619, by Sir Henry Savile, Knight, Warden of Merton College. The Professors may be chosen from any part of Christendom, provided they are persons of good character and repute, well skilled in mathematics, and twenty-six years of age; if Englishmen, they must be M. A., at the least. The following list gives the names of the holders of the Professorship since its foundation:

1619.	Henry Briggs.	1766.	John Smith.
1631.	Peter Turner.	1797.	Abram Robertson.
1649.	John Wallis.	1810.	Stephen Rigaud.
1704.	Edmund Halley.	1827.	Baden Powell.
1742.	Nathaniel Bliss.	1861.	Henry J. S. Smith.
1765.	Joseph Betts.	1883.	J. J. Sylvester.

(*From the Honors Register of the University of Oxford*, 1883).

The construction of a new building, in order to provide the members of the University with facilities for gymnastic exercises, was authorized by the Board of Trustees early in June last. Work in accordance with that vote was actively pushed forward from the middle of June until December 7, when the completed building, with its fittings and furniture, was opened to the public for inspection. The gymnasium has been planned to meet the requirements of 250 persons, and especial pains have been taken to secure an abundance of light and air in the main hall and in the dressing rooms connected with it. Until further notice it will be open to all members of the University from 9 a. m. till 9 p. m., daily, except Sunday.

Matriculate students will hereafter be required, in order to secure the degree of Bachelor of Arts, to take the course in Physical Culture. Announcements in detail concerning the nature and requirements of this course will be made at an early day.

The ground plan of the building in which the gymnasium and dressing rooms are contained resembles in shape a letter L turned thus ┏. The main building of the ┏ abutting on Garden street is 104 feet in length, includes the gymnasium proper and a vestibule, and the wing of the ┏ extending from Garden street to the rear of Bentley Hall is nearly 85 feet in length. The entrance to the building is on Garden street at the junction of the main building and the wing of the ┏. The entrance is through a vestibule, out of which, upon the first floor, doors open into the main hall and into the private dressing rooms, while on the second floor at the head of a flight of steps, is the door of the Director's rooms, in which the physical examinations are made and recorded. The vestibule and gymnasium hall are in the new building; while the dressing and bath rooms, and the offices of the Director are in the wing.

The main hall comprises a single room, open to the roof, and has a total height from floor to ridge pole of 43 feet. It has upwards of 3400 square feet of flooring; its walls, of painted brick, are 25 feet high and 18 inches thick; and each of its side walls contains 7 high and wide windows whose sills are seven feet from the floor.

A very complete set of Dr. Sargent's developing appliances is ranged against the walls on the four sides of the room, and a variety of apparatus such as is usually found in gymnasiums has also been provided.

In the dressing rooms a large number of private lockers are placed, besides bath tubs and set bowls supplied with hot and cold water.

The gymnasium is a place for "body-building" and a place for recreation. It will be administered as far as possible in accordance with the plan followed by Dr. Sargent (in the Hemenway Gymnasium of Harvard University). The purpose is to give to each individual guidance and counsel based upon and determined by a careful examination of his *physique*. It is held that the end and aim of physical training is to enable the body to do with pleasure and ease all the work of which as a mechanism it is capable.

E. M. H.

During the latter part of this academic year, after the return of Dr. G. Stanley Hall, a course of lectures will be given to graduate students and others who are preparing themselves for the work of teachers in colleges and high schools. The particulars in regard to this course are not fully arranged but the topics presented will be nearly as follows:—

1. The Present State of University and Collegiate Instruction in this country, by D. C. **Gilman**.
2. Recent Observations on Educational Foundations in Europe, by D. C. **Gilman**.
3. The Educational Value of Grammar, by B. L. **Gildersleeve**.
4. The Future Sphere of Classical Philology, by B. L. **Gildersleeve**.
5. Educational Value of the Study of Chemistry, by **Ira Remsen**.
6. What to Teach in Biology, by H. **Newell Martin**.
7. One Lecture by H. A. **Rowland**.
8. The Observational Element in Mathematics, by C. S. **Peirce**.
9. The *a priori* Element in Physics, by C. S. **Peirce**.
10. The *naive* in Education, by H. **Wood**.
11. Modern Methods in the Study of History, by H. B. **Adams**.
12. Methods of Comparative Philology as pursued to-day, by M. **Bloomfield**.
13. The New Impetus given to the Study of Latin by the application of the Historical Method and by the Study of Inscriptions, by **Minton Warren**.
14. Hygiene in Collegiate Training, by E. M. **Hartwell**.
15. Rhythm and Education, by G. **Stanley Hall**.
16. The Educational Value of Specialization and Original Work, by G. **Stanley Hall**.
17. On the Uses of Libraries in Education, by D. C. **Gilman**.

Assemblies of the matriculated students have been held on successive Fridays during the current session, under the direction of the President of the University. Informal lectures on subjects pertinent to collegiate life have been given by various members of the academic staff, and on one occasion the members of the class in History brought forward the results of some of their studies. These assemblies will be continued during the remainder of the academic year.

The Matriculated Students of this university including those who are candidates for the degree of B. A. are more than fifty in number, and are most of them from the State of Maryland. Several of them live in the neighborhood of Baltimore and are absent from their homes during the whole day. For the benefit of all this company of students, two rooms have been set apart by the Trustees and appropriately furnished,—one to be a place for quiet study, where dictionaries and other reference books may be found; and the other to be a parlor for conversation, and the reading of current newspapers and magazines.

To promote the interests of this important body of students, and to secure the proper care of these rooms, an Association has been formed under the name of "The Matriculate Society." Its officers are: President, W. L. Glenn; Vice President, E. G. Miller, Jr.; Secretary, G. D. Penniman; Executive Committee, the President, Vice-President, Secretary, A. C. Woods, C. H. Howard, L. Williams, and J. Hinkley; Committee on Rooms, E. G. Miller, Jr., W. R. Orndorff, J. M. Horner; Committee on Literary Exercises, A. C. Woods, W. K. Williams, J. S. Hodges; Committee on Entertainments, G. D. Penniman, G. G. Carey, Jr., R. H. Bayard.

Dr. **Charles S. Hastings**, Associate Professor of Physics, who has been connected with this institution since 1876, has accepted an invitation to the chair of Physics in the Sheffield Scientific School of Yale College, and will leave Baltimore at the close of the current academic year. His resignation was presented to the Trustees at their meeting in December, and a resolution was adopted expressing their acknowledgments for his past services and their regrets at his prospective departure.

Mr. W. P. **Durfee**, who received the degree as Doctor of Philosophy here in June last, has been appointed Instructor in charge of the department of Mathematics, in Hobart College, Geneva, N. Y.

Mr. E. W. **Bemis** has resigned his graduate scholarship here, to accep a position upon the editorial staff of the St. Paul (Minnesota) *Pionee Press.*

Dr. **Walter B. Platt**, after passing the usual examinations was ad mitted to the degree of Fellow in the Royal College of Surgeons in Lon don, November 24, 1883.

The *American Journal of Mathematics* for December, 1883 (Vol. VI No. 2), contains papers:

On Compound Determinants, by C. A. Van Velzer;—Note on Weie strass' Methods in the Theory of Elliptic Functions, by A. L. Daniels;— On Quadruple Theta-Functions, by Thomas Craig;—Principles of th Solution of Equations of the Higher Degrees, with Applications, (con tinued), by George Paxton Young;—Resolution of Solvable Equation of the Fifth Degree, by George Paxton Young;—On Certain Possibl Abbreviations in the Computation of the Long-Period Inequalities of th Moon's Motion due to the Direct Action of the Planets, by G. W. Hill;— Semi-Invariants and Symmetric Functions, by Capt. P. A. MacMahon, B A;—A Graphic Method of Solving Spherical Triangles, by Charles E Smith;—Extract from a letter to Mr. Sylvester from M. Hermite.

The *American Chemical Journal* for November, 1883, (Vol. V, No. 5, contains the following papers:

On the Use of Mercury Thermometers with Particular Reference to th Determination of Melting and Boiling Points, by J. M. Crafts;—On th Action of Aldehydes on Phenols, by Arthur Michael and A. M. Comey Laboratory Notes, III, by Arthur Michael;—Researches on the Com plex Inorganic Acids, by Wolcott Gibbs;—Contributions from the Chem ical Laboratory of Harvard College;—Communications from the Chemica Laboratory of Rutgers College.

No. XII. of *Studies in Historical and Political Science* (Local Govern ment and Free Schools in South Carolina, by B. J. Ramage), has jus appeared. This completes the first series, which comprises 470 pages an twenty distinct papers collected in twelve special groups. Subscriber are furnished with a complete Index to the first volume of the Studie and with a general title-page, including the special sub-heading, *Loca Institutions*, which will serve to characterize the contents of the firs volume.

A second Series of University Studies, comprising about 500 page in twelve monthly monographs, devoted to *Institutions*, *Economics*, and *Politics*, is offered to subscribers at the former rate, $3. A before, a limited number of Studies will be sold separately, although a higher rates than to subscribers for the whole set. The first number o the New Series will shortly be published. It is entitled "New Method of Study in History," and was read before the American Social Scienc Association, at Saratoga, September 4, 1883.

The very limited number of complete sets of the First Series now remaining in the hands of the Publication Agency of the Universit compels the announcement that no further subscriptions for this volum can be received at the original rate. The few sets on hand, bound in cloth, will be sold at $5 net, by the *Publication Agency* only. The futur interests of the work represented by this journal will require the Agenc to give preference, in disposing of the remainder of the First Series, t libraries, specialists, and other patrons who are likely to prove continuou subscribers to the Studies.

A synopsis of the contents of *American Journal of Philology*, for October, 1883, (Vol. IV, No. 3,) is given on page 44.

Notes by Professor Sylvester.

With regard to the extract from Professor Cayley's note to me inserte in the last number of the *Circular*, I hasten to say that it was inserted b me without waiting to receive his sanction to the publication and that h has since written to me to inform me that the result is erroneous. J. J. S.

Errata in Circular No. 27. (P. 9, 2d column, line 31)—for "If *to* each term" read "If *from* each term;"—(foot note *, p. 12)—for "$(x,y)^{\omega-1} = 0$" read "$(x, y)^{\omega-1}(z, t)^{\omega-1} = 0$." J. J. S.

SCIENTIFIC COMMUNICATIONS

Most or all of which have been read before Societies or Classes in this University.

MATHEMATICS.

On the Three Laws of Motion in the world of Universal Algebra. By PROFESSOR SYLVESTER.

[Substance of a lecture given on December 7, 1883, to the Mathematical Fellows at the Johns Hopkins University].

In the preceding *Circular* allusion was made to the three cardinal principles or conspicuous landmarks in Universal Algebra; these may be called, it seems to me (without impropriety), its Laws of Motion, on the ground that as motion is operation in the world of pure space, so operation is motion in the world of pure order, and without claiming any exact analogy between these and Newton's laws, it will be seen that there is an element in each of the former which matches with a similar element in the latter, so that there is no difficulty in pairing off the two sets of laws and determining which in one set is to be regarded as related by affinity with which in the other. They may be termed the law of *concomitance* or *congruity*, the law of *consentaneity* and the law of *mutuality* or *community*.

The law of congruity is that which affirms that the latent roots of a matrix follow the march of any functional operation performed upon the matrix, not involving the action of any foreign matrix; it is the law which asserts that any function of a latent root to a matrix is a latent root to that same function of the matrix; in so far as it regards a matrix *per se*, or with reference solely to its environment, it obviously pairs off with Newton's first law.

The law of *consentaneity*, which is an immediate inference from the rule for combining or multiplying substitutions or matrices, is that which affirms that a given line (or parallel of latitude) can be followed out in the matrices resulting from the continued action of a matrix upon a fixed matrix of the same order, *i. e.* in the series M, mM, M^2m, m^3M, . . . (which may be regarded as so many modified states of the original matrix) without reference to any other of the lines or parallels of latitude in the series, or again any column or parallel of longitude in the correlated series M, Mm, Mm^2, . . . without reference to any other such column or parallel of longitude.

An immediate consequence of this obvious fact (a direct consequence for the rule of multiplication) obtained by dealing at will with either of the systems of parallels referred to, is that a system of simultaneous linear equations in differences may be formed for finding each term in any given line or in any given column at any point in the series, and the integration of these equations leads at once to the conclusion that any term of given latitude and longitude in the ith term of either series is a syzygetic function of the ith powers of the latent roots of m.

If, then, M be made equal to multinomial unity, this at once shows that supposing ω to be the order of m, on substituting m for the *carrier* (or latent invariable) in the latent function to m, and multiplying the last term by the proper multinomial unit, the matrix so formed is an absolute null, which proves the proposition concerning the "identical equation" first enunciated by Professor Cayley in his great paper on Matrices in the *Phil. Trans.* for 1858.

This proposition admits of augmentation, 1°, from within, as shown in a former note, by applying to it the limiting law of the nullity of a product (a branch of the 3d law), which leads to the very important conclusion that the nullity of any factor of the function of a matrix which is an absolute null, or more generally of any product of powers of its linear factors, is exactly equal to the number of distinct linear factors which such factor or product contains, at all events, in the general case where the latent roots are all unequal; and 2°, from without, by substituting for m, $m + \epsilon n$ where n is any second matrix whatever and ϵ is an infinitesimal. This leads to the *catena* of identities, to which allusion has been made in the preceding *Circular*. Then, again, the *endogenous* growth of the theorem (that which determines the exact nullity of any factor of the left hand side of the identical equation) in its turn seems to lead to a remarkable theorem concerning the form of the general term of any power of m into M.

Observe that every such term is expressed as a syzygetic function of powers of the ω latent roots, and contains, therefore, ω constants, so that the total number of syzygetic multipliers is ω^3; but the number of variables in m and M together is $2\omega^2$; and, consequently, apart from the ω arbitrary latent roots the number of independent constants in m^iM should be $2\omega^2 - \omega$. The ω^3 syzygetic multipliers ought then to contain only $\omega(2\omega - 1)$ arbitrary constants, and such will be found to be the case by virtue of the following hypothetical theorem: Calling λ any one of the latent roots, the multipliers of λ^i in m^iM will form a square of ω^2 quantities; the theorem in question [*] is that every minor of the second order in such square is zero, so that the ω^2 terms in the square is given when the bounding angle containing $2\omega - 1$ terms is given; and the same being true for the multipliers of each latent root (which restore themselves into ω squares) the number of arbitrary quantities in all is $\omega(2\omega - 1)$ as has to be shown.

The law of *consentaneity* in so far as it relates to the decomposition of the motion of a matrix into a set of parallel motions, has an evident affinity with Newton's second law.[†]

Remains the law of mutuality which is concerned with the effect of the mutual action upon one another of two matrices and so claims kindred with Newton's third law.

This law branches off into two, one which may be termed the law of reversibility, the other that of co-occupancy or permeability.

The law of reversibility affirms that the latent function of the product of two matrices is independent of the sense in which either of them operates upon the other, *i. e.*, is the same for mn as for nm, just as the kinetic energy developed by the mutual action of two bodies is not affected by their being supposed to change places.

As regards the second branch of the third law, the word co-occupancy refers to the fact that although the space occupied by two similarly shaped figures (say two spheres) is not absolutely determined (in the absence of other data) by the spaces occupied by them each separately (for they may intersect or one of them coincide with or contain the other) a superior as well as an inferior limit to such joint occupation is so determined; the inferior limit being the space occupied by either such figure, *i. e.*, the *dominant* of these two given spaces, and the superior limit their arithmetical sum. So the nullity resulting from the action in either sense of two matrices upon one another is not given when their separate nullities are assigned but has for an inferior limit the dominant of these two nullities and for a superior limit their sum; the nullities of the two component matrices may also be conceived under the figure of two gases or other fluids which are mutually *permeable* and capable of occupying each other's pores.

Although the limits spoken of are independent of the sense in which the two matrices act on one another, it must not however be supposed that the actual resultant nullity is unaffected by that circumstance; thus, *ex. gr.*, if the latent roots of a ternary matrix m are λ, λ', λ'', the nullity resulting from $(m - \lambda)(m - \lambda')$ acting sinistrally upon $(m - \lambda'')n$, *i. e.*, of $(m - \lambda)(m - \lambda')(m - \lambda'')n$ is 3 but from the same acting dextrally upon the same, *i. e.*, of $(m - \lambda'')n(m - \lambda)(m - \lambda')$ need not necessarily exceed 2.

Such then are the three primary Laws of Algebraical Motion; but as Conservation of areas, *Vis viva*, D'Alembert's Principle, the principle of Synchronous Vibrations of Least action, and various other general laws may be deduced from Newton's three ground laws, so, of course, various subordinate but very general laws may be deduced from the interaction of the above stated three ground laws, viz., the law of Congruity, the law of Consentaneity, and the law of Mutuality.

The deduction of the catena of identical equations connecting two matrices m and n from the second and third laws combined, affords an instance of such derivative general laws. Another instance of the same is

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[*] I have not had leisure of mind, being much occupied in preparing for my departure, to reduce this theorem to apodictic certainty. I state it therefore with all due reserves.

[†] For another and closer bond of affinity between the two laws see concluding paragraph of this note.

A pretty exhaustive exploitation of this poem yields the following result: cunquis*e*, quis*e* et rove*e* (117), done*e* (118), quis*e* et assemble*e* (139), ralii*e* (?) (147), mene*e* (161), assemblei*z* (167), entreoci*s* (180), entroci*s* (219), vencu*e* (242), matei*z* (266), rendu*e* (302), pris*e* (305), assis*e* (306), attaint*e* (351), coneü*e* (411), perdu*e* (522), laissei*z* (600), laissie*z* (606), rassemblei*e* (611), finei*e* (833), devisei*e* (834), oï*e* (1001), vencu*z* (1058), baisi*e* et blandi*e* (1121), pris*e* (1200), chargie*s* (1275), raloï*e* (1393), covrei*e* (1415), raloï*e* (1532), devisei*e* (1533), commenci*e* (1596), menei*e* (1600), deviseie*s* (1631), ordeneie*s* (1632), sevrei*e* (1764), conquis*e* (1871), poplei*e* (1887), eschacie*z* (2015), mis*e* (2025), poplei*e* (2038), trovei*e* (2045), apelei*e* (2046), donei*e* (2080), deviseie*s* (2135), ordeneie*s* (2136), feru*z* (2168), clamei*e* (2182), mor*z* et detrenchie*z* (2186), ameneie*s* (2197), precie*s* (2198), pris*e* (2286), amei*e* (2291), tornei*e* (2292), commandei*e* (2299), menei*e* (2311), recelei*e* (2312), hautei*e* (2313), engendrei*e* (2314), nomei*e* (2316), demostre*e* (2335), ame*e* (2337), gete*e* (2338), deguerpi*e* (2339), fait*e* (2340), recint*e* (2348), assemblei*e* (2362), aünei*e* (2367), engendrei*e* (2401), deguerpi*e* (2487), fai*z* (2514), destrui*z* (2530), passei*e* (2538), devisei*e* (2539), poplei*e* (2542), nummei*e* (2543), ameie*s*, (2602), honoreie*s* (2603), tramise*s* (2605), ramenei*e* (2665), apelei*e* (2672), araisunei*e* (2822), apelei*e* (2823), finei*e* (2842), entendue*s* (2856), ordenei*e* (2861), celei*e* (2864) mostrei*e* (2865), cuntredit*e* (2891), trovei*e* (2913), blasmei*e* (2914), finei*e* (2915), doeie*s* (2927), mostrei*e* (2958), demandei*e* (2959), ahireteie*s* (2975), oï*e* (2978), respiti*e* (2979), entendu*e* (2985), quis*e* (3007), furni*e* (3008), chargi*e* (3009), menei*e* (3013), livrei*e* (3014), jurei*z* (3124), sofert*e* (3218), demandei*e* (3301), fait*e* (3425) assemblei*e* (3455), adunei*z* (3457), livrei*z* (3458), menei*e* (3465), resaisi*e* (3507), desheritei*z* (3509), mandei*z* (3510), rendu*z* (3511), tolu*z* (3512), coronei*e* (3521), assegurei*e* (3522), mande*e* (3587), aüne*e* (3588), mene*e* (3589), commenci*e* (3602), assemble*e* (3603), mis*e* (3608), perdu*e* (3615), devise*e* (3621), aquite*e* (3622), parti*e* (3651), mandie*z* (3661), ars*e* et gaste*e* (3664), defendu*e* (3668), vencue (3669), saisi*e* (3706), exquis*e* (3720), done*e*, (3755), tenu*e* (3759), laissi*e* (3764), nomei*e* (3883), sacrei*e* (3884), pris*e* (3896), mis*e* (3902), veü*e* (3939), trovei*e* (3881), perdu*e* (4030), fait*e* (4038), trovei*z* (4053), portei*z* (4054), servi*z* (4087), nurri*z* (4088), cummenci*e* (4157), assiz*e* (4166).

(*a*) Of these 117, 118, 139, 147, 161, 167, 242, 302, 306, 411, 522, 600, 606, 1058, 1121, 1275, 1393, 1415, 1532, 1533, 1596, 1600, 1631, 1632, 1764, 1871, 2015, 2038, 2045, 2046, 2080, 2135, 2182, 2186, 2197, 2198, 2291, 2299, 2314, 2316, 2335, 2337, 2338, 2339, 2340, 2348, 2362, 2367, 2401, 2487, 2514, 2538, 2539, 2542-43, 2602-3, 2605, 2665, 2672, 2823, 2856, 2861, 2865, 2890-1, 2914-15, 2925-26-27, 2958, 2975-78-79-85, 3007-8-9, 3013-14, 3218, 3301-2, 3455-7-8, 3465, 3511-12, 3588-9, 3602-3-8, 3616, 3622, 3651, 3661, 3664, 3076, 3720, 3755, 3760-4, 3883-4, 3939, 4030-38, 4053-54, 4087-88, 4166, have in every case the direct object before both auxiliary (*avoir*) and participle.* This object is sometimes pronominal, sometimes substantival.

(*b*) 97, 685, 831, 1055, 1231, 1292, 1365, 1571, 2035, 2195, 2923, 3015, 3165, 3714, have (1) participle, (2) auxiliary, (3) object, in the order here named.

(*c*) 219, 1051, 1626, 2016, 2268, 3825, 3981, have (1) participle, (2) object, (3) auxiliary, in the order here named.

(*d*) 241, 305, 351, 611, 833-4, 1001, 2025, 2103, 2286, 2292, 2311-12-13, 2822, 2864, 3124, 3415, 3507-9, 3521-2, 3587, 3621, 3667-8, 3896, 3902, 4157, have (1) auxiliary, (2) object, (3) participle.

(*e*) 153, 191, 1531, 1887, 2060, 2334, 2515, 2559, 2583, 3012, 3245, 3523, 3596, 3631, 3759, 3797, 3886, 3991, have (1) auxiliary, (2) participle, (3) object.

Observation: In l. 4038 pp. with faire agrees with a fem. pronoun: Si l' a *faite* vive enfoïr.

2. Does the past participle, in tenses compounded with AVOIR, fail to agree with the direct object?

Ll. 1884, 2210, 2247, 2427, 2668, 3404, (respectively, fait, mis, receü, pris remis, menei,) show the cases of non-agreeing participles, which govern their object without change of form.

(*a*) Of these 2210, 2247, 2427, 3404, have the object after the participle and auxiliary, in the order: auxiliary, participle, object.

(*b*) 2668 has the participle before the auxiliary and object.

(*c*) 1884 has (1) object, (2) auxiliary, (3) participle.

Observation: In 2499 the participle fails, as in modern French, to agree with a preceding specification of time:

Quant *li vint an* furent passei
Que rois Mempricies out *regnei*.

Sum.: The past participle agrees with the direct object in 157 instances; fails to agree or governs without agreeing in 6 instances. In 115 of the instances of agreement the order is (1) object, (2) auxiliary, (3) participle, (or, in a few instances, (1) object, (2) participle, (3) auxiliary) as in modern French. Great freedom of position prevails, as the data show, partly due to poetic considerations, partly due to the fluctuating uncertainties of French word-order at that time.

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* Occasionally, as in 1275 and 522, the order is: direct object, participle, auxiliary.

On an Etymology of Isidore. (*A Philological Conundrum.*) By J. Rendel Harris.

In an appendix to the treatise of Isidore, *De Ortu et Obitu Patrum* (ed. Arevalus. t. vii. p. 395), we find as follows: "*Lucas* qui interpretatur *elevans sive consurgens*, evangelista tertius." I have been much puzzled to determine the philological process employed by Isidore (Pseudo. Isidore), or the earlier writer whom he quotes.

It seems that the following is the solution of the difficulty:

(*a*). The derivation is from the Hebrew language, to which all the names in the appendix to *De Ortu et Obitu Patrum* are referred. For example, Philippus interpretatur *os lampadis* = פִּי לַפִּיד; Thomas interpretatur *abyssus* = תְּהוֹם.

Moreover, it is to the Hebrew language that Patristic philologians most frequently refer. The treatise De Nominibus Hebraicis, (Migne, Patr. Latina, tom. 23), bound up with the works of St Jerome, but probably of a considerably earlier date, finds a Hebrew origin for almost every name in the New Testament, including Gaius, Demetrius, and Diotrephes.

On the other hand there are some bright instances of *Greek* philology, as when Euthalius teaches that Saul was so called ὅτι ἐσάλευε τὴν ἐκκλησίαν, and Paul was the name given him ὅτι πέπαυται, because he left off his wicked ways.

But with regard to the passage in question, a Hebrew derivation is the more probable.

(*β*). This supposition is confirmed by a reference to Cod. Coislin. ccxxiv, from which Tischendorf gives extracts in his Anecdota Sacra et Profana.

The MS. contains Ἑρμηνεία ἑβραικῶν ὀνομάτων τῶν ἐν ταῖς πράξεσι τῶν ἀποστόλων ἐμφερομένων κατὰ στοιχεῖον ἡρμηνευμένη. And we find as follows:

Λούκιος = αὐτὸς ἀνιστῶν
Λυκαονία = τοῦ ἀναστῆσαι.

(*γ*). The first of these suggests a compound mood of some Hebrew verb; the second, an articular infinitive, involves the prefex ל. Taking the root קוּם, we have for the Hophal infinitive with the prefix as suggested לְהוּקַם, which is evidently the proper form to represent the word *Lucam*.

One would hardly have imagined that the study of comparative philology had been carried so far as this in the fourth or fifth century.

On the Introductory Words of the Muratorian Canon. By J. Rendel Harris.

The fragment containing the so-called Canon of Muratori opens as follows:

quibus tamen interfuit et ita posuit
TERTIO EVANGELII LIBRUM SECANDO LUCAM.
lucas iste medicus post acensum XPI
cum eo paulus quasi ut iuris studiosum
secundum adsumsisset numeni suo
ex opinione concriset. dnm tamen nec ipse
dvidit in carne et ide pro asequi potuit
ita et ad nativitate iohannis incipet dicere.

The words printed in capitals are rubricated in the original document: and the text is edited as follows by Westcott. (On the Canon of N. T., p. 523).

quibus tamen interfuit et ita posuit. Tertium Evangelii librum secundum Lucam. Lucas iste medicus post ascensum Christi cum eum Paulus quasi ut juris studiosum secundum adsumsisset nomine suo ex opinione conscripsit. Dominum tamen nec ipse vidit in carne, et idem prout assequi potuit, ita et a nativitate Johannis incepit dicere.

In the third line of the fragment I propose to read *Lucas iste medicus Antiochensis*. To justify this emendation observe (which is not apparent from Westcott's text) that *Christi* stands outside of the line and has been added by the rubricator. In the next place the missing letter *s* in *ascensum* has been added by a later hand, according to Ceriani (s superscriptum manu dubia).

I believe *post acensum* to be a correction for *ante acensum* and this latter to be a corruption of *antiocensis*.

The following quotations will show how common is the tradition which makes St. Luke a native of Antioch, or which is for our purpose almost an equivalent statement, a Syrian.

1. *Eusebius. Eccl. Hist.* iii. 4. *Λουκᾶς δὲ τὸ μὲν γένος ὢν τῶν ἀπ' Ἀντιοχείας, τὴν δὲ ἐπιστήμην ἰατρὸς τὰ πλεῖστα συγγεγονὼς τῷ παύλῳ καὶ τοῖς λοιποῖς δὲ οὐ παρέργως τῶν ἀποστόλων ὡμιληκὼς ἧς ἀπὸ τούτων προσεκτήσατο ψυχῶν θεραπευτικῆς ἐν δυσὶν ἡμῖν ὑποδείγματα θεοπνεύστοις καταλέλοιπε βιβλίοις.*

2. *Euthalius*, in his edition of the Acts (Migne, Patr. Graec. tom. 85, col. 633) furnishes the following statement:

πρῶτον περὶ ὧν Λουκᾶς ὁ εὐαγγελιστὴς συνέταξε, προοιμιασάμενος. Ἀντιοχεὺς γὰρ οὗτος ὑπάρχων τὸ γένος, ἰατρός τε τὴν ἐπιστήμην πρὸς παύλου μαθητευθεὶς, δύο βίβλους συνεγράψατο.

And we find this statement again, almost word for word in Cramer's Catena, as the Introduction to the Acts:

Ἀντιοχεὺς ὑπάρχων τὸ γένος ὁ Λουκᾶς ἰατρὸς τὴν ἐπιστήμην, ὁ ὑπὸ παύλου μαθητευθεὶς, δύο βίβλους συνεγράψατο κτέ.

It is evident that the passage in the Catena is either taken from Euthalius, or from some one of the fathers whose work Euthalius incorporated with his own.

3. *Jerome, De viris illustribus, c.* 7.

Lucas medicus Antiochensis, ut ejus scripta indicant, Græci sermonis non ignarus fuit, sectator apostoli Pauli et omnis peregrinationis ejus comes, etc.

4. The *Codex Amiatinus* of the Vulgate provides us with the following prologues:

a. Tertius Lucas medicus, natione Syrus Antiochensis, cujus laus in evangelio, qui et ipse discipulus apostoli Pauli in Achaiæ Bœotiæque partibus volumen condidit, quædam altius repetens et, ut ipse in prohemio confitetur, audita magis quam visa describens.

b. Lucas Syrus natione, Anthiocensis, arte medicus, discipulus Apostolorum, postea Paulum secutus* usque ad confessionem ejus, serviens domino sine crimine nam neque uxorem umquam habens neque filios, lxxiiii annorum obiit in Bythinia plenus spiritu sancto. Qui cum jam descripta essent evangelia, per Matthæum quidem in Judea, per Marcum autem in Italia, sancto instigante spiritu in Achaiæ partibus hoc scripsit evangelium, significans etiam ipse in principio ante alia esse descripta: cui extra ea quæ ordo evangelicæ dispositionis exposcit ea maxime necessitas fuit laboris ut primum græcis fidelibus omni perfectione venturi in carne dei manifestata ne judaicis fabulis intenti in solo legis desiderio tenerentur neve hereticis fabulis et stultis sollicitationibus seducti excederent a veritate elaboraret: dehinc ut, in principio evangelii Johannis nativitate præsumta, cui evangelium scriberet et in quo electus scriberet indicaret, contestans in se completa esse quæ essent ab aliis inchoata, etc.

5. The collections of Isidore add some important statements to the preceding, and as is so often the case with that writer, the extracts bear marks of high antiquity.

Isidor. Hisp. (ed. Arevali) vii, 395. Lucas, qui interpretatur elevans sive consurgens, evangelista tertius, natione Syrus, Antiochensis, cujus laus in evangelio canitur, arte scriba et medicus, apostolorum discipulus, postea Paulum usque ad confessionem ejus secutus, serviens Domino sine crimine. Nam neque uxorem umquam habens, neque filios, medicus corporum et animarum. Duos etenim libros de spirituali medicina animarum scripsit, id est evangelium in Achaiæ partibus tempore Pauli, quod evangelium Paulus Apostolus(ait) esse suum ait enim secundum evangelium meum, alium vero librum qui Actus Apostolorum dicitur quem sancto Theophilo episcopo Antiocheno conscripsit, lxx et iiii annorum obiit in Bethania, plenus Spiritu Sancto, qui postea Constantinopolim xx Constantino imperatoris anno cum reliquiis beati apostoli Andreæ translatus est cujus depositio xv. kal novemb. celebratur.

6. Idem. v. 187. Lucas Antiochenus evangelista et apostolicæ conscriptor historiæ, natione Syrus, arte medicus, græco eloquio eruditus quem plerique tradunt proselytum fuisse, et hebræas literas ignorans. Hic tamen fuit Pauli discipulus et individuus comes peregrinationis ejus. Quique ab ineunte pueritia castissimus fuit et evangelicæ prædicationis opus exercuit Obiit septuagesimo quarto vitæ suæ anno. Sepultus in Bithynia; cuius quidem ossa, regnante Constantino Constantinopolim fuerunt translata.

Here, then, are at least seven fragments of traditional evidence, bearing striking analogies to the Muratorian Canon, and favoring strongly the suggested emendation. And the only counter evidence that I know of is the statement in the subscriptions to the Gospel of Luke, in Codd. KS, to the following effect: *ἐξεδόθη μετὰ χρόνους ιέ τῆς τοῦ χῦ ἀναλήψεως.*

Assuming the accuracy of the emendation, we shall see further that these traditions become much more intelligible when placed side by side; and in order to make the comparison more carefully and completely, we can add several other passages belonging to the traditional history of St. Luke, and it is easy and interesting to examine the accretion and development of the tradition.

BIOLOGY.

Evidence of a Protozoea Stage in Crab Development. By H. W. CONN.

[Abstract of a communication to the University Scientific Association, November 7, 1883.]

There is great interest attached to speculations as to the probable ancestry of the Decapods, owing to the value which the conclusions have in enabling us to interpret paleontological facts. There have been quite a number of theories advanced as to the original stem from which the Decapods have been derived, two of which claim especial attention. One is the theory of Müller, who finds such a stem form in the zoea. Another, suggested by Claus, or in a different form by Brooks, considers the protozoea as the ancestral stem. It is of great importance in understanding the Crustacea to decide between these two views, inasmuch as by the first view Crustacea are supposed to have descended from a form without a thorax, while according to the second, the thorax was present in the original Decapod stem. Some work done at Hampton during the last summer upon the larval cuticle of crabs, indicates conclusively that the latter view is the correct one, or that at least Fritz Müller's view is incorrect. The larval skin, particularly the telson, of a large number of crab zoeas was studied with the following results: The larval skin is not in different crabs alike, nor is it in any case exactly similar to the inclosed zoea. There is always an indication, more or less complete, of some previously existing stage. There has been shown in the various forms studied a gradation from the larval skin, with little difference from the zoea inclosed, to a larval skin which is utterly unlike the zoea, but which possesses a forked tail with 14 long feathered spines. This gradation is complete, and a study of the different embryonic telsons shows that all have been derived from the form shown by Panopeus, which has a forked tail with 14 spines. Now such a larval skin is to be considered simply as the cast off skin of some stage immediately preceding the zoea. It has been shown by Paul Meyer that the study of the larval skin of Macroura leads to a similar result, that a forked tail with 14 spines is also seen in the early history of this group. If, therefore, a form can be found which shows these peculiarities, we have reason for accepting it as the stem form of the higher Crustacea. Now a study of the different protozoea forms which occur in the ontogeny of various Macroura shows that we have in this form a stage which fulfils the conditions. It has the forked tail with 14 spines, and has large swimming antennae, another peculiar characteristic of the crab larval cuticle. If the various larval skins of crabs and Macroura be compared with each other, it will be seen that they are all to be considered as modifications of a tail much like that present in the larval skin of Panopeus; and if this tail be compared with the protozoea tail of Peneus, the likeness will be seen to be very striking. We have, therefore, in the comparative study of the larval cuticle of crabs, good reason for accepting as the stem form of the Decapods a form which had resemblance to a protozoea.

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* The MS. is clearly wrong in placing the comma after *secutus*, and equally incorrect in putting a full stop after *crimine*.

NOTES ON RECENT PUBLICATIONS.

Remsen, Ira. Principles of Theoretical Chemistry, with special reference to the Constitution of Chemical Compounds. (Second Edition, Revised and Enlarged.) (*Philadelphia: Henry C. Lea's Son & Co. 242 pp., 12^{mo}. $1.75.*)

In one way or another students of Chemistry manage to learn a great many of the facts of the science, but in most cases their knowledge of the underlying principles is sadly defective. They talk glibly enough of atoms and molecules, of "bonds" and "double bonds," of valence and structure, but if asked a fundamental question the character of the answer is pretty sure to reveal an unsatisfactory state of mind. This is largely due to the way in which chemistry is commonly taught. Beginners are brought face to face with the deepest subjects with which the most learned chemist can occupy himself. They are made to study certain "cut and dried" statements regarding atoms and bonds, etc., before they have formed any conception in regard to the nature of chemical action, and having once learned some definition of atoms and atomic weights, etc., having once learned to repeat Avogadro's law and the law of Dulong and Petit, they are allowed to go on their way under the fatal impression that they really know something about the subjects. The best of them, if they happen to come under good influences or if they have enough individuality, may recover from the barbarous treatment to which they have been subjected. Many never do recover from it.

The object of the book here noticed is to furnish the student with a logical statement of the connection between the fundamental facts and hypotheses of chemistry, to show how the latter are suggested by the former and to point out the boundary line between them. It is intended for those who have some knowledge of the facts.

In the first part the methods for determining atomic and molecular weights are treated as fully as is necessary to make the subject clear. Then follows a chapter on the "Properties of the Elements as Functions of their Atomic Weights," and one on "Valence, or Atomicity of Elements."

In the second division, which forms the principal part of the book, the much abused, yet important, subject of the Constitution or Structure of Chemical Compounds is taken up. The attempt has been made to show exactly how the prevailing views regarding structure have been evolved from the facts. The formulas in use for the principal compounds are discussed in such a way as to draw attention to the methods involved in constructing them. A careful study of this portion should put the student in a condition to see upon what basis the formulas in common use rest, and ought to do something towards remedying the serious and prevalent evil of writing formulas "because they are in the book."

The treatise concludes with a short chapter on the Determination of the Constitution of Chemical Compounds by Physical Methods.

Archives of Maryland. Proceedings and Acts of the General Assembly of Maryland, January, 1637/8—September, 1664. Published by authority of the State under the direction of the Maryland Historical Society. J. W. M. Lee, Bradley T. Johnson, Henry Stockbridge, Publication Committee;—William Hand Browne, Editor. (*Baltimore:* 1883. *621 pp., 4°. $2.50*).

In placing the colonial records of the Province, and revolutionary records of the State, in the custody of the Historical Society, and making provision for their publication, the Assembly has taken a precaution which, if its predecessors fifty or a hundred years ago had taken, grievous and wholly irreparable loss would have been prevented. Yet Marylanders have great cause to be thankful that through all the chances and changes which have imperilled these manuscript records, so much has been preserved, and now, by proper safeguards, and still more, by publication, is placed beyond the risk of further loss.

Each of the colonies started on its career under circumstances, internal and external, more or less peculiar, by which its destinies were shaped from the first, and which, even at the present day, are to some extent the cause that each is what it is. Each had its own enemies to combat, its own prosperity to work out or defend, and each, in its own way, cherished that spirit of freedom which in due time was to make it an independent Commonwealth. In the case of Maryland, the first Proprietary government that succeeded, and the first colony that was successful from the start, the study of this period of its history, though lacking in those tragic and stirring events which give such deep interest to the early struggles of Virginia and New England, is of high importance as an instance of the growth of free institutions in a community which had the shaping of these institutions almost entirely in its own hands, and which adapted, by methods as simple as efficient, the social order and government of England in the 17th century—or so much of them as was needed—to a new settlement in a new world, and under external conditions that England had not known for a thousand years.

As these Archives are chiefly intended for the historian or student of history, great care has been taken in the editing to make the printed text an exact and literal copy of the manuscript, so that the book may be consulted as if it were the original, and with as much confidence.

A most valuable addition to this volume, is the careful calendar of all the unpublished volumes and their contents; so that the student can at once learn what materials bearing on his researches are preserved among these Archives.

It can hardly be doubted that the publication of this volume will be satisfactory to the Legislature of the State, and that it will make provision for continuing the series.

Titles of Recent Contributions to Periodicals, etc.

Billings, J. S. Medical Bibliography. (*Medical and Chirurgical Faculty of Maryland, Transactions, 1883.*)

——— The Information necessary to determine the merits of the Heating and Ventilation of a School Building. (*Circulars of Information* (*No. 2, of 1882*) *Bureau of Education, Washington, 1883.*)

Bloomfield, M. On Certain Irregular Vedic Subjunctives and Imperatives. (*American Oriental Society, Proceedings, May, 1883.*)

——— On a Proposed Edition of the Kāuçika-sūtra of the Atharva-Veda. (*American Oriental Society, Proceedings, October, 1883*)

Dewey, J. Knowledge and the Relativity of Feeling. (*Journal of Speculative Philosophy, January, 1883.*)

Gildersleeve, B. L. Grammar and Aesthetic. (*Princeton Review, May, 1883.*)

Hall, G. Stanley. The Contents of Children's Minds. *Princeton Review, May, 1883.*)

Harris, J. R. Original Documents of the New Testament. (*The Century, N. Y., December, 1883.*)

Haupt, Paul. Beiträge zur Assyrischen Lautlehre. (*K. Gesellschaft der Wissenschaften, Nachrichten, Göttingen, April 25, 1883.*)

——— Supplement to Schrader's Keilinschriften und das alte Testament. (*Ricker, Giessen, 1883.*)

Johnson, J. Rudimentary Society among Boys. (*Overland Monthly, October, 1883.*)

Liebig, G. A. Variation of the Specific Heat of Water. (*American Journal of Science, July, 1883.*)

Martin, H. N. Direct Action of Ethyl Alcohol upon the Heart. (*Maryland Medical Journal, September, 1883.*)

Remsen, I. Chemistry and Pharmacy. *Popular Science Monthly, May, 1883.*)

Rowland, H. A. On Concave Gratings for Optical Purposes. (*Philosophical Magazine, September, 1883; American Journal of Science, August, 1883.*)

——— On Mr. Glazebrook's paper on the Aberration of Concave Gratings (see Phil. Mag., June, 1883). (*Philosophical Magazine, September, 1883; American Journal of Science, September, 1883.*)

Schimper, A. F. W. Ueber die Entwickelung der Chlorophyllkörner und Farbkörper. (*Botanische Zeitung, 1883.*)

Sylvester, J. J. Table of Totients, of Sumtotients, and of $3/\pi^2$ into the Squares, of all the Numbers from 501 to 1000 inclusive. (*Philosophical Magazine, September, 1883.*)

——— On the Equation to the Secular Inequalities in the Planetary Theory. (*Ib., October, 1883.*)

——— On the Involution and Evolution of Quaternions. (*Ib., November, 1883.*)

Wilhelm, L. W. The Poll Tax in Maryland. (*Magazine of American History, January, 1884.*)

Williams, G. H. Die Eruptivgesteine der Gegend von Tryberg im Schwarzwald. (*Inaugural Dissertation, Heidelberg, 1883.*)

REPORTS OF RECENT LECTURES AND ADDRESSES.

I. Dr. von Holst's Lectures on the Relation of History to Politics, etc.

Two public courses of lectures by distinguished writers on history have been given here since the opening of this session. The first course was a careful and at times an eloquent review of the Relation of History to Politics, with illustrations drawn from modern European history. The lecturer was DR. H. VON HOLST, Professor in the University of Freiburg, who had previously lectured here in the winter of 1879, and is well known as the author of the Constitutional History of the United States.

THE RELATION OF HISTORY TO POLITICS.

It is impossible to understand European politics without understanding European history. If you would study the present character of European states and the tendencies of the nineteenth century, you must begin at least as far back as the French Revolution. The lecturer considered in a philosophical way the *ancien régime*, the causes and results of the Revolution. He showed that while feudal institutions were levelled to a democratic plain, the monarchical principle survived in the most absolute form. Liberty, equality, fraternity, were but idle dreams. France has always looked for political guidance to men rather than to measures or principles. The French people are not republican in the same sense as are the people of the United States or of Switzerland. These countries have not only republican institutions but republican traditions, habits, and modes of thought. Dynastic monarchy is dead in France although monarchical feeling survives. Devotion to the Bourbons was extinct long before the natural death of the Count de Chambord. The Orleans princes have never won the hearts of the French people. The Germans of to-day are under great obligations to the French Revolution and to Napoleon I. If old Germany had not been thoroughly shaken up, the country would now be a geographical name and a political corpse. But modern Germany has paid back her debt with interest, and the day will come when France will acknowledge it. The French have profited by the lesson of 1870 in their thorough reorganization, civic and military, and also in their educational system. Excessive centralization at Paris was one of the chief obstacles to French liberty. But the Paris Commune taught France to depend upon herself as a united country instead of upon one city. The death of Gambetta has been a great blessing to France, for, just because of his great qualities, the French people continued to believe in one man rather than in public measures. The present generation of French statesmen must learn to keep themselves in the saddle by deeds rather than by prestige. The existing relations between France and Germany were freely discussed and the international position of Germany as regards Russia, Austria, and other powers was suggestively defined. The policy of Germany is peace, but with readiness for immediate and overpowering war. American competition in economic ways will however finally compel the disarmament of Europe. The internal condition of Germany received some attention from the lecturer. The German Empire is daily growing into a more organic unit, and, whatever political and social dissensions there may be within German borders, the German people have no confidence in foreign war as a safety-valve for the nation.

* * *

Before leaving Baltimore, Dr. von Holst met the students of History and Political Science by themselves and urged upon them the study of Slavery as an historic, economic, and social Institution. A fuller report of this address will probably be printed in the University Studies of Historical and Political Science.

Few people considered the late civil war as an irrepressible conflict. It was not so considered by the man who coined the phrase. Neither Seward nor Lincoln, neither North nor South understood the irrepressible nature of the conflict into which the nation was drifting. This view is impossible even in our time, because the history of slavery has not yet been written. There has been no attempt to write it. There are, indeed, works which indicate by their titles some bearing upon the subject of slavery, but a scientific treatise upon the same there is not. Accounts of the slavery *question* there are in abundance, but slavery as an historic Institution is yet to be studied. Until the thing itself is known, it is impossible to treat it understandingly in the history of political controversy. Students from the South, trained to a knowledge of scientific methods, should take up the history of slavery — the peculiar institution. Study the slaveholders as such; study their position, occupations, modes of life, their intercourse with the outside world. Investigate the history of landed property or land tenure in the Southern States. Inquire into their commercial relations; what articles were imported and what things were not imported. Study the history of the southern press and of southern literature. Such inquiries would show to some extent the character of southern civilization. No individual can complete this great task. It will be a work for the coming century. But individuals can contribute a stone to the up-building of this historical structure and by and by it will be finished. Whoever takes up such work with interest, diligence, and strict conscientiousness may expect results which will entitle him to the praise: "He has deserved well of his country."

II. Mr. Bryce's Lectures on the History of the Sources of Roman Law.

The second public course of lectures in history was given by JAMES BRYCE, Esq., M. P., Regius Professor of Civil Law in the University of Oxford, author of a work on the Holy Roman Empire. In a course of six lectures he called attention to the importance of the study of Roman Law, and indicated the mode in which the subject should be taken up and the results to which it might lead.

ROMAN LAW.

The lectures began with some observations on the nature and value of the historical method as applied to legal studies, and upon the place which a study of Legal History ought to hold in the general history of the institutions of a state and the life of a people.

The term "Sources of Law" was then explained as including the persons or bodies from whom the law of a State proceeds, and the methods and channels by and through which it is expressed and promulgated. A sketch was then given of the conditions under which law existed in early Rome, during the regal period and in the first two centuries of the republic. The nature of Customary Law was discussed, and the importance of the priests as the depositaries of sacred customs and ceremonial usages in primitive societies was indicated. The Laws of the Twelve Tables were then touched upon, and remarks made on their great value as forming a centre for the subsequent systematic development of Roman Law and a basis for its teaching. Some account was given of the way in which statutes were passed by the comitia of the people, and the consequences which legislation by such assemblies produced were examined. After this the position of the legal profession at Rome was treated of, and the way in which the *prudentes* became, as teachers and writers, sources of law, was illustrated from similar phenomena in England and America. Special reference was made to the action of Augustus and his successors in giving certain jurists the privilege of issuing authoritative *responsa*, and to the growth and influence of the Sabinian and Proculian schools. Next the position and powers of the Roman magistrates, and especially of the Prætor as an executive and judicial officer, were discussed, and it was shown that, by his control over procedure and through his edicts, he became a source of law of the first importance. The meaning of *jus gentium* was explained, its growth traced, and the philosophical conception of *naturalis ratio* was dwelt upon. Some words were said in conclusion upon the legislation of the Senate and the Emperors, and the character of Justinian's codification, or rather consolidation, of the two great masses of statute law and jurist law was briefly touched upon.

DEMOCRACY IN AMERICA.

Mr. Bryce also met the members of the Seminary of Historical and Political Science on November 23, and made some remarks in criticism of De Tocqueville's "Democracy in America."

After dwelling upon the rare and admirable qualities of De Tocqueville's work, almost without a parallel in modern political literature for keen analysis, exquisitely lucid statement, and judicial fairness, Mr. Bryce indicated several points in which De Tocqueville's observations might seem open to criticism, as affected by certain possibly misleading influences. Among these some critics might enumerate an inadequate appreciation of the English element in the institutions and political habits of the American people, a similarly scarcely adequate appreciation of the effects of colonial life, a somewhat too constantly present disposition to try American phenomena by comparison with those of France, and conceive those which are unlike France to be distinctively American, together with a view of political methods and institutions slightly too theoretical, and needing to be corrected by the experience of practical politicians.

The question was then proposed whether certain points in De Tocqueville's description of the phenomena he saw in 1833 were correct then, although not true now, or whether he had erred in his observation of the then actual condition of the United States. Among these points were the following: The arbitrary powers of American magistrates, the tyranny of the majority in America, the absence of free thought and free speech, the eager interest of every citizen in political affairs, the tendency of State authority to encroach on federal authority and the predominance of State patriotism over national patriotism, the number and variability of small political parties. These topics were briefly discussed, and the suggestion made that an edition of De Tocqueville's great work carefully annotated so as to show which of his reflections and forecasts had stood the test of time and comparing the past with the present condition of the United States might possess considerable historical and political value.

III. Dr. Billings's Lectures on Municipal Hygiene.

Dr. J. S. Billings, Surgeon U. S. A., who has been for several years the medical adviser of the Trustees of the Johns Hopkins Hospital, in respect to the construction of their buildings, has completed a course of twelve lectures upon the Municipal Hygiene, which was listened to by many physicians, by the health officers and other municipal authorities of Baltimore, and by such members of the university as are interested in sanitary science. The lecturer discussed the general principles which apply to the health control of cities and the illustrations were largely derived from the experience of Baltimore. The daily newspapers furnished excellent reports of most of his lectures, so that their influence was extended far beyond the company who heard them.

SYNOPSIS OF RECENT JOURNALS.

American Journal of Philology. Edited by Professor Gildersleeve. Vol. IV, 3. Whole No. 15.

Article I.—The New Revision of King James' Revision of the New Testament. III. Examination of the Revision of S. Matthew (continued). By Charles Short.

In this number Professor Short continues his exhibit of the various renderings of S. Matthew from ch. vii to ch. xii inclusive (see A. J. P., II. 149-180, III. 139-169).

The character of the article precludes a synopsis. Among the matters that come up for discussion may be noted the use of the article in couplings, *e. g. the east and* (*the*) *west*, both in English and in Greek, the suppression of the verb in the second clause, as in *the hervest is great, and the woorkmen few* (Sir John Cheke), the repetition of the preposition, the use of *that*, *how*, *how that*.

Article II.—On the English Dative-Nominative of the Personal Pronoun. By F. B. Gummere.

The later change of *ye* to *you* must be connected with the earlier like tendency in the singular. After the dative had driven out the accusative forms of the personal pronoun it turned toward the nominative. In fact it had long performed nominative functions, as is shown by the construction with *self*, as is shown by the definite article *the*, which is undoubtedly a dative, *se* being the nominative proper. In the XVth century we find, *To-morrow shall you wedded be* (Guy of Warwick). But it is sporadic and the new form gained ground at first very slowly. In the Paston Letters there is no gain in the later period (1485-1509) over the earlier (1424-1461). In nearly a century there is not the slightest indication of such a change as might have been anticipated. But in the Kentish Aȝenbite of Inwyt written (1340) a century before the Paston Letters, there is a use of the dative-nominative in the second person of the singular personal pronoun that would justify the prophecy of a speedy substitution of *thee* for *thou*. But just then the plural was substituted for the singular. *Ye* became the more polite form of address in the XVth and XVIth centuries. The singular was isolated, a hedge was set about it. It was reserved for solemn purposes, and was thus removed from the influence of linguistic change. It became one of those forms that men use consciously with effort; just as we use *ye* with effort. Most men use any case of the singular personal pronoun, second person, only on special occasions and with this conscious effort. Most men, but not all. *Thee* is familiar to the Society of Friends though few use *thou* in familiar speech.

The change went on with *thou* and *thee*, and the dialectic dative-nominative of the Aȝenbite of Inwyt was used for *thou* with no more right and no less right than *you* for *ye*. The explanation from euphony is idle. If euphony is to blame why did not euphony retain *ye?* The *ou* in *thou* was not a diphthong at the time of change. The reason is hard to discover. Schleicher attributes the usurpation to a certain shyness. 'Me seems' is preferred to 'I see.' At any rate the tendency was helped by the analogy of the impersonal verbs in dative construction, which also had its effect on the form of verb. The modern Quaker *thee* does not take a verb to correspond. The Quaker says *thee shall, thee multiplies.*

The conclusion is that the household *thee* of modern Quakers is no more "ungrammatical" (Dr. Abbott) than the household *you* of anybody else. Only in solemn language does the former use *thee* or the latter *ye*. If it be urged that some dialects have retained the *thou*, we have simply to remember that the same is true of *ye* and does not interfere with the fact that *thee* is now a legitimate nominative.

Article III.—Participial Periphrases in Attic Prose. By W. J. Alexander.

This is substantially Dr. Alexander's thesis for the degree of Doctor of Philosophy. An abstract will be found in *Circular No. 22* with an extended note on the subject by Professor Gildersleeve.

Article IV.—Stichometry, II. By J. Rendel Harris.

In this paper Mr. Harris extends his previous results to Bible texts, and discussed at length the Euthalian stichometry (see *Circular No. 25*). The majority of the data agree closely with the hexameter hypothesis as is shown by a comparison between a measured selected text of the Epistles and the traditional verse numberings. Although there is greater irregularity in the Gospels than in the Epistles, it must be admitted that in both cases (but especially in the Epistles), they offer a new critical instrument to the student of the New Testament by means of which to restore the text to the same compass as it occupied in early copies. True the extension of the enquiry to the Gospels is much complicated by the variety of texts, the *Textus Receptus*, for example, showing an excess of at least 50 hexameters in the Gospel of Matthew over the text of Westcott and Hort, but it is so much the more interesting for we begin at once to ask such questions as relate to the authenticity of the last twelve verses of Mark, the *pericope de adultera* and other important passages. As all the texts of the Gospels are in defect according to the best preserved stichometry, we must assume a shorter measuring line for the Gospels with the result that a modern text was found to be only five verses in excess in Matthew, if it was in excess at all, that it was within a single verse of the traditional number in Mark, and not more than five verses in excess in John. The last twelve verses of the Gospel of Mark must be admitted to make up the reckoning, and for the same reason we are obliged to reject John VII. 53, to VIII. 11. In Luke the longer of two available results requires the rejection of most of these passages which Westcott and Hort designate as Western non-interpolations. This would leave the measured texts some nine verses in excess of the traditional numbers. In no case does the *Textus Receptus* afford us a reasonable concordance with the traditional figures. The later MSS. thus appear as witnesses against themselves.

There are three elaborate *Reviews*, one by Professor J. M. Garnett of Sweet's *Anglo-Saxon Reader* and *Anglo-Saxon Primer* and Morris' *Specimens of Early English*, one by Professor Francis Brown of Schrader's *Keilinschriften und das alte Testament* with Haupt's *Appendix* and one by Professor J. F. McCurdy, of the new edition of *Gesenius' Lexikon*. Professor Bloomfield has given a *Notice* of Bühler's *Leitfaden fur den Elementarcursus des Sanskrit*, and Professor G. S. Morris, of Wallace's ΑΡΙΣΤΟΤΕΛΗΣ ΠΕΡΙ ΨΥΧΗΣ. The *Reports* embrace *Rheinisches Museum*, (J. H. Wheeler), *Anglia*, (J. M. Garnett), *Hermes*, (E. G. Sihler.).

In the *Correspondence*, Dr. J. R. S. Sterrett communicates a corrected copy of inscriptions from Sebasté in Asia Minor. The usual select bibliographical list completes the number.

PUBLIC LECTURES.

(The regulations in regard to the admission of the public to these courses of lectures are given on p. 30 of this *Circular*).

VI. BOTANY.

Professor **WILLIAM TRELEASE**, Botanist, of the University of Wisconsin, will give a course of class lectures to the students in the Biological Laboratory on *The Growth and Reproduction of Plants*, during the month of January, 1884, as follows:

1. Analysis of Plant Structure.
2. The Cell in general; the Cell-wall.
3. Protoplasm.
4. Cell Multiplication.
5. Synthesis of Plant Structure.
6. Osmosis in its relation to Nutrition; Nutrition of Lower Plants.
7. Nutrition and Growth of Higher Plants.
8. Parasitism; Symbiosis; Carnivorous Plants.
9. Reproduction — lower plants.
10. Reproduction — higher plants.
11. Dissemination.
12. Germination.

FERTILIZATION OF FLOWERS.

He will also give a course of four lectures on *The Fertilization of Flowers*, in Hopkins Hall, on Thursdays, January 3, 10, 17, 24, at 5 p. m.

VII. NEW TESTAMENT GREEK.

J. **RENDEL HARRIS**, M. A., (late of Clare College, Cambridge, England) Lecturer on New Testament Greek, will give a course of six lectures explanatory of some new methods of textual restoration, on Wednesdays and Fridays, January 2, 4, 9, 11, 16, and 18.

In the first instance, the second and third epistles of St. John will be restored to the original lines and pages. A brief examination will be made of the extent to which these epistles are attested by the Fathers and the substantial value of such attestations, &c., &c.

VIII. ETHICS OF SOCIAL RELATIONS.

Professor **GEORGE S. MORRIS**, Lecturer on Philosophy, will give four lectures on the *Ethics of Social Relations*, Tuesdays, January 8, 15, 22, and 29, as follows:

I. *Tuesday, January 8.* On the Philosophy of Social Relations generally.
II. *Tuesday, January 15.* The Family.
III. *Tuesday, January 22.* The State.
IV. *Tuesday, January 29.* Religion and Social Relations; or, God in History.

IX. ENGLISH LITERATURE.

HIRAM CORSON, M. A., LL. D, Professor of Anglo-Saxon and English Literature in the Cornell University, will give a course of twenty lectures on the *Poetry and Drama of the Restoration Period, and on the subsequent Drama to Sheridan, inclusive*, beginning Monday, January 21, 1884.

The lectures will be given on Mondays, Wednesdays, and Fridays, January 21, 23, 25, 28, 30, February 1, 4, 6, 8, 11, 13, 15, 18, 20, 25, 27, 29, March 3, 5, 7.

1. *Monday, January 21:* Introduction to the Course; the spiritual, as distinguished from the intellectual, an essential of literature; the spiritual ebb and flow exhibited by successive periods of English literature, from Chaucer to the present time.

2. *Wednesday, January 23:* The Odes on the Lord Protector, Cromwell, and on the Restoration of Charles II., by Waller, Dryden, Cowley, Sprat (Bishop of Rochester), and others; the rhetoric of the "metaphysical" school of John Donne.

3. *Friday, January 25:* The same subject continued; the Anti-Puritan spirit of the time and its tendencies.

4. *Monday, January 28:* The same subject continued.

5. *Wednesday, January 30:* The same subject continued; Cowley's "Vision concerning his late pretended Highness, Cromwell the Wicked."

6. *Friday, February 1:* Butler's Hudibras, the completest and most effective embodiment of the Anti-Puritan spirit; Milton and Butler contrasted as reflectors of Puritanism.

7. *Monday, February 4:* The charge against Puritanism of destroying the English Drama, refuted; the great gush of the dramatic spirit in the Elizabethan age quite spent before Puritanism became a power.

8. *Wednesday, February 6:* The Restoration Drama Characterized; the Comic Drama an expression of the hunger and thirst of the time after unrighteousness; the Latinized Court of Charles II., its poisoned fountain-head.

9. *Friday, February 8:* The "Heroic" Play regarded as the "bright consummate flower" of the dramatic genius of the age; Dryden, its most successful cultivator; his "Essay on Heroic Plays;" his "Indian Emperor," "Tyrannic Love," and "Conquest of Granada;" the "Heroic" Plays burlesqued in "The Rehearsal" of the Duke of Buckingham; Dryden's portrait of the Duke in his "Absalom and Achitophel."

10. *Monday, February 11:* Dryden's estimate of the great Elizabethan Dramatists, Shakespeare, Ben Jonson, Beaumont and Fletcher, etc.; his "Defence of the Epilogue" to his Comedy, "Marriage à la Mode;" Thomas Rymer's "Reflections on Shakespeare and other Practitioners for the Stage," contained in his "Short View of Tragedy;" Dryden's high estimate of Rymer as a critic.

11. *Wednesday, February 13* Rymer continued; his criticisms of Shakespeare's Othello and Julius Cæsar, etc., expressive of the low dramatic ideals of the time.

12. *Friday, February 15:* The *rifacimenti* of Shakespeare's Plays, by Davenant, Dryden, Nahum Tate, Otway, Granville, etc. Davenant's "Macbeth;" Dryden and Davenant's "Tempest, or, the Enchanted Island."

13. *Monday, February 18:* Nahum Tate's "King Lear," as exhibiting the age's idea of "poetic justice;" the great impersonators of Lear, Burbage, Betterton, Garrick, Edmund Kean, Macready.

14. *Wednesday, February 20:* Dryden's concrete estimates of Chaucer and Milton, as exhibited in his modernizations of Chaucer and his rhymed opera of "The State of Innocence and Fall of Man."

15. *Monday, February 25:* The Dedications of the time, a measure of the literary debasement.

16. *Wednesday, February 27:* The Collier Controversy: Collier's "Short View of the Immorality and Profaneness of the English Stage."

17. *Friday, February 29:* The Collier Controversy continued; Replies of Congreve, Vanbrugh and others; the reformation wrought by Collier in the Morality of the Stage; Charles Lamb's remarkable theory as to the Comedy of the Restoration wholly sophistical.

18. *Monday, March 3:* The improved Morality of the Court and of Society after the Revolution of 1688; Addison's "Cato;" the "Sentimental" or "Genteel" Comedy, as represented by Richard Steele and others; Addison and Steele as moral reformers.

19. *Wednesday, March 5:* The revolt against the Sentimental Comedy instituted by Oliver Goldsmith in his "Good-Natured Man" and "She Stoops to Conquer."

20. *Friday, March 7:* Sheridan's "Rivals" and "The School for Scandal;" general survey of the Drama from Shakespeare to Sheridan; the Future of the Drama.

N. B. This Programme is somewhat provisional; a few modifications may be necessary, and parts of a subject assigned to a lecture of a certain date may be treated in a preceding or a following lecture.

The course of lectures on Classical Archæology by Mr. Joseph Thacher Clarke, previously announced, have been deferred in consequence of the sickness of Mr. Clarke.

A pretty exhaustive exploitation of this poem yields the following result: cunquis*e*, quis*e* et rove*e* (117), done*e* (118), quis*e* et assemble*e* (139), raliie (?) (147), mene*e* (161), assembleiz (167), entreocis (180), entrocis (219), vencu*e* (242), mateiz (266), rendu*e* (802), pris*e* (305), assis*e* (306), attaint*e* (351), coneü*e* (411), perdu*e* (522), laisseiz (600), laissiez (606), rassemblei*e* (611), finei*e* (838), devisei*e* (834), oï*e* (1001), vencuz (1058), baisi*e* et blandi*e* (1121), pris*e* (1200), chargies (1275), raloï*e* (1398), covrei*e* (1415), raloï*e* (1532), devisei*e* (1533), commenci*e* (1596), menei*e* (1600), deviseies (1631), ordeneies (1632), sevrei*e* (1764), conquis*e* (1871), poplei*e* (1887), eschaciez (2015), mis*e* (2025), poplei*e* (2038), trovei*e* (2045), apelei*e* (2046), donei*e* (2080), deviseies (2135), ordeneies (2136), feruz (2168), clamei*e* (2182), morz et detrenchiez (2186), ameneies (2197), precies (2198), pris*e* (2286), amei*e* (2291), tornei*e* (2292), commandei*e* (2299), menei*e* (2311), recelei*e* (2312), hautei*e* (2318), engendrei*e* (2314), nomei*e* (2316), demostre*e* (2335), ame*e* (2337), gete*e* (2338), deguerpi*e* (2339), fait*e* (2340), recint*e* (2348), assemblei*e* (2362), aünei*e* (2367), engendrei*e* (2401), deguerpi*e* (2487), faiz (2514), destruiz (2580), passei*e* (2538), devisei*e* (2539), poplei*e* (2542), nummei*e* (2548), ameies, (2602), honoreies (2603), tramises (2605), ramenei*e* (2665), apelei*e* (2672), araisunei*e* (2822), apelei*e* (2823), finei*e* (2842), entendues (2856), ordenei*e* (2861), celei*e* (2864) mostrei*e* (2865), cuntredit*e* (2891), trovei*e* (2918), blasmei*e* (2914), finei*e* (2915), doeies (2927), mostrei*e* (2958), demandei*e* (2959), ahireteies (2975), oï*e* (2978), respiti*e* (2979), entendu*e* (2985), quis*e* (3007), furni*e* (3008), chargi*e* (3009), menei*e* (3013), livrei*e* (3014), jureiz (3124), sofert*e* (3218), demandei*e* (3301), fait*e* (3425) assemblei*e* (3455), aduneiz (3457), livreiz (3458), menei*e* (3465), resaisi*e* (3507), desheriteiz (3509), mandeiz (3510), renduz (3511), toluz (3512), coronei*e* (3521), assegurei*e* (3522), mande*e* (3587), aüne*e* (3588), mene*e* (3589), commenci*e* (3602), assemble*e* (3603), mis*e* (3608), perdu*e* (3615), devise*e* (3621), aquite*e* (3622), parti*e* (3651), mandiez (3661), ars*e* et gaste*e* (3664), defendu*e* (3668), vencue (3669), saisi*e* (3706), exquis*e* (3720), done*e*, (3755), tenu*e* (3759), laissi*e* (3764), nomei*e* (3883), sacrei*e* (3884), pris*e* (3896), mis*e* (3902), veü*e* (3939), trovei*e* (3881), perdu*e* (4030), fait*e* (4038), troveiz (4053), porteiz (4054), serviz (4087), nurriz (4088), cummenci*e* (4157), assiz*e* (4166).

(*a*) Of these 117, 118, 139, 147, 161, 167, 242, 302, 306, 411, 522, 600, 606, 1058, 1121, 1275, 1398, 1415, 1532, 1533, 1596, 1600, 1631, 1632, 1764, 1871, 2015, 2038, 2045, 2046, 2080, 2135, 2182, 2186, 2197, 2198, 2291, 2299, 2314, 2316, 2335, 2337, 2338, 2339, 2340, 2348, 2362, 2367, 2401, 2487, 2514, 2538, 2539, 2542-48, 2602-3, 2605, 2665, 2672, 2823, 2856, 2861, 2865, 2890-1, 2914-15, 2925-26-27, 2958, 2975-78-79-85, 3007-8-9, 3013-14, 3218, 3301-2, 3455-7-8, 3465, 3511-12, 3588-9, 3602-3-8, 3616, 3622, 3651, 3661, 3664, 3076, 3720, 3755, 3760-4, 3883-4, 3939, 4030-38, 4053-54, 4087-88, 4166, have in every case the direct object before both auxiliary (*avoir*) and participle.* This object is sometimes pronominal, sometimes substantival.

(*b*) 97, 685, 881, 1055, 1231, 1292, 1365, 1571, 2035, 2195, 2928, 3015, 3165, 3714, have (1) participle, (2) auxiliary, (3) object, in the order here named.

(*c*) 219, 1051, 1626, 2016, 2268, 3825, 3981, have (1) participle, (2) object, (3) auxiliary, in the order here named.

(*d*) 241, 305, 351, 611, 833-4, 1001, 2025, 2103, 2286, 2292, 2311-12-18, 2822, 2864, 3124, 3415, 3507-9, 3521-2, 3587, 3621, 3667-8, 3896, 3902, 4157, have (1) auxiliary, (2) object, (3) participle.

(*e*) 153, 191, 1531, 1887, 2060, 2334, 2515, 2559, 2583, 3012, 3245, 3523, 3596, 3631, 3759, 3797, 3886, 3991, have (1) auxiliary, (2) participle, (3) object.

Observation: In l. 4038 pp. with faire agrees with a fem. pronoun: Si l' a *faite* vive enfoïr.

2. Does the past participle, in tenses compounded with AVOIR, fail to agree with the direct object?

Ll. 1884, 2210, 2247, 2427, 2663, 3404, (respectively, fait, mis, receü, is remis, menei,) show the cases of non-agreeing participles, which vern their object without change of form.

(a) Of these 2210, 2247, 2427, 3404, have the object after the participle th xiliary, in the order: auxiliary, participle, object.

663 has the participle before the auxiliary and object.

884 has (1) object, (2) auxiliary, (3) participle.

---

* [illegible] as in 1275 and 522, the order is: direct object, participle, auxiliary.

Observation: In 2499 the participle fails, as in modern French, to agree with a preceding specification of time:

Quant *li vint an* furent passei
Que rois Mempricies out *regnei*.

Sum.: The past participle agrees with the direct object in 157 instances; fails to agree or governs without agreeing in 6 instances. In 115 of the instances of agreement the order is (1) object, (2) auxiliary, (3) participle, (or, in a few instances, (1) object, (2) participle, (3) auxiliary) as in modern French. Great freedom of position prevails, as the data show, partly due to poetic considerations, partly due to the fluctuating uncertainties of French word-order at that time.

On an Etymology of Isidore. (*A Philological Conundrum.*) By J. Rendel Harris.

In an appendix to the treatise of Isidore, *De Ortu et Obitu Patrum* (ed. Arevalus. t. vii. p. 395), we find as follows: "*Lucas* qui interpretatur *elevans sive consurgens*, evangelista tertius." I have been much puzzled to determine the philological process employed by Isidore (Pseudo. Isidore), or the earlier writer whom he quotes.

It seems that the following is the solution of the difficulty:

(*a*). The derivation is from the Hebrew language, to which all the names in the appendix to *De Ortu et Obitu Patrum* are referred. For example, Philippus interpretatur *os lampadis* = פִּי לַפִּיד; Thomas interpretatur *abyssus* = תְהוֹם.

Moreover, it is to the Hebrew language that Patristic philologians most frequently refer. The treatise De Nominibus Hebraicis, (Migne, Patr. Latina, tom. 23), bound up with the works of St Jerome, but probably of a considerably earlier date, finds a Hebrew origin for almost every name in the New Testament, including Gaius, Demetrius, and Diotrephes.

On the other hand there are some bright instances of *Greek* philology, as when Euthalius teaches that Saul was so called *ὅτι ἐσάλευε τὴν ἐκκλησίαν*, and Paul was the name given him *ὅτι πέπαυται*, because he left off his wicked ways.

But with regard to the passage in question, a Hebrew derivation is the more probable.

(*β*). This supposition is confirmed by a reference to Cod. Coislin. ccxxiv, from which Tischendorf gives extracts in his Anecdota Sacra et Profana.

The MS. contains *Ἑρμηνεία ἑβραικῶν ὀνομάτων τῶν ἐν ταῖς πράξεσι τῶν ἀποστόλων ἐμφερομένων κατὰ στοιχεῖον ἡρμηνευμένη*. And we find as follows:

Λούκιος = αὐτὸς ἀνιστῶν
Λυκαονία = τοῦ ἀναστῆσαι.

(*γ*). The first of these suggests a compound mood of some Hebrew verb; the second, an articular infinitive, involves the prefex ל. Taking the root קוּם, we have for the Hophal infinitive with the prefix as suggested לְהוּקַם, which is evidently the proper form to represent the word *Lucam*.

One would hardly have imagined that the study of comparative philology had been carried so far as this in the fourth or fifth century.

On the Introductory Words of the Muratorian Canon. By J. Rendel Harris.

The fragment containing the so-called Canon of Muratori opens as follows:

quibus tamen interfuit et ita posuit
TERTIO EVANGELII LIBRUM SECANDO LUCAM.
lucas iste medicus post acensum XPI
cum eo paulus quasi ut iuris studiosum
secundum adsumsisset numeni suo
ex opinione concriset. dnm tamen nec ipse
dvidit in carne et ide pro asequi potuit
ita et ad nativitate iohannis incipet dicere.

The words printed in capitals are rubricated in the original document: and the text is edited as follows by Westcott. (On the Canon of N. T., p. 528).

quibus tamen interfuit et ita posuit. Tertium Evangelii librum secundum Lucam. Lucas iste medicus post ascensum Christi cum eum Paulus

n. 332.

JOHNS HOPKINS UNIVERSITY CIRCULARS

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CALENDAR, 1883-84.

uesday, September 18.	**Current Academic Year Began.**
riday, April 11.—Monday, April 14, (inclusive).	**Spring Recess.**
londay, June 2.—Friday, June 6.	**Examinations for Matriculation.**
riday, June 6.	**Term of Instruction Closes.**

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STANDING ANNOUNCEMENTS.

JOHNS HOPKINS UNIVERSITY.

Opened for Instruction in 1876.

The Johns Hopkins University was founded by the munificence of a citizen of Baltimore, Johns Hopkins, who bequeathed the most of his large estate for the establishment of a University and a Hospital. It was intended that these institutions should coöperate in the promotion of medical education. The Hospital buildings are approaching completion.

The foundation of the University is a capital, in land and stocks, estimated in value at more than $3,000,000; the capital of the Hospital is not less in amount.

The University was incorporated under the laws of the State of Maryland, August 24, 1867. Power to confer degrees was granted by the Legislature in 1876.

Suitable buildings have been provided in Baltimore at the corner of Howard and Little Ross Sts., and are furnished with the necessary apparatus and books.

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OTTO LUGGER, *Curator of the Biological Museum.*

PLAN OF THE CIRCULARS.

The Johns Hopkins University Circulars are published at convenient intervals during the academic year for the purpose of communicating intelligence to the various members of the University in respect to work which is here in progress, as well as for the purpose of promulgating official announcements from the governing and teaching bodies. During the current academic year, successive circulars may be expected in the months of November, January, March, April, May, and June, to be followed at the close of the year by an Index.

Although these circulars are designed for the members of the University, they have frequently been called for by institutions and libraries at a distance, and also by individuals who are interested in the literary and scientific activity of this University. Subscriptions and exchanges are therefore received.

TERMS OF SUBSCRIPTION.

For the current year, 1883-4, one dollar.

For the year 1882-3, (156 pp. in cloth covers), $2.

For the years 1880-2, (250 pp. in cloth covers), $5.

Subscribers to the Circulars will also receive the Annual Register and Report of the University.

All subscriptions should be addressed to the "Publication Agency of the Johns Hopkins University."

Communications for the Circulars should be sent in prior to the first day of the month in which they are expected to appear.

HOPKINS HALL LECTURES.

Notice in Respect to the Admission of the Public.

In answer to inquiries, and in correction of some current misapprehensions, the following statements are made in respect to these courses of lectures annually given in the Johns Hopkins University.

1. These courses are academic lectures, designed primarily for the members of the University, and supplementary to the regular class-room work of the students.

2. As the members of the University rarely require the entire room, the Trustees have taken great pleasure in inviting other persons, not connected with the University, to attend.

3. As these lectures are not intended for popular entertainment, but for the instruction of students, those persons first receive tickets, in most cases, who are known to be especially interested in a particular course,—ladies as well as gentlemen. Preference is thus given according to the character of the course, to teachers in other institutions, public and private; students of medicine, law, etc.; professional men and others. If any tickets remain undistributed, they are given out to those who may have applied for them, in order of application.

4. The hall is full when 200 hearers are present; it is uncomfortable if more are admitted. Not infrequently two or three times that number of persons apply for admission, and often applications for tickets cannot be granted. To give the lectures elsewhere would alter their character as a part of the ordinary academic work of the University.

5. *There is no general course ticket issued.* Applications should state specifically the course for which tickets are desired. Programmes and other current information pertinent to university work may be found in the *University Circulars*, sent to subscribers on the payment of one dollar per annum, either by Messrs. Cushings & Bailey, Messrs. John Murphy & Co., or the University.

The usage of giving personal notification is not likely to be continued, and those therefore who have been accustomed to receiving such announcements, should hereafter consult the *Circulars.*

6. It will save much delay if applications for tickets and inquiries on these and other routine matters are addressed not to individuals but to the JOHNS HOPKINS UNIVERSITY, *by postal card*, and answers will be promptly returned by mail. Personal applications consume time needlessly.

☞ The lectures begin at 5 o'clock *punctually.* The doors of the hall are opened at fifteen minutes before 5, and the lectures do not exceed an hour in the delivery.

PUBLICATIONS ISSUED UNDER THE AUSPICES OF THE UNIVERSITY.

I. American Journal of Mathematics.

The publication of this journal commenced in 1878, under the editorial direction of Professor Sylvester. Five volumes of about 400 pages each have been issued, and the sixth is in progress. It appears quarterly, in the quarto form. Subscription $5 per year. Single numbers $1.50.

II. American Chemical Journal.

This journal was commenced in 1879, with Professor Remsen as editor. Five volumes of about 450 pages each have been issued, and the sixth is in progress. It appears bi-monthly. Subscription $3 per year. Single numbers 50 cts.

III. American Journal of Philology.

The publication of this journal commenced in 1880, under the editorial direction of Professor Gildersleeve. Three volumes of about 570 pages each have been issued, and the fourth is in progress. It appears four times yearly. Subscription $3 per volume. Single numbers $1.00.

IV. Studies from the Biological Laboratory.

[Including the Chesapeake Zoölogical Laboratory.]

The publication of these papers commenced in 1879, under the direction of Professor Martin, with the assistance of Dr. W. K. Brooks. Two volumes of about 500 pages, octavo, and 40 plates each, have been issued, and the third is in progress.

V. Studies in Historical and Political Science.

The publication of these papers was begun in 1882, under the editorial direction of Dr. H. B. Adams. The first volume of 470 pages is now completed, and the second is in progress. Subscription $3 per volume.

The following publications are also issued by the University:

The UNIVERSITY CIRCULARS. Subscription $1 per year.

The ANNUAL REPORT presented by the President to the Board of Trustees reviewing the operations of the University during the past academic year.

The ANNUAL REGISTER giving the list of officers and students and stating the regulations of the University. Published at the close of the academic year.

The JOURNAL OF PHYSIOLOGY, edited by Professor Michael Foster, of Cambridge, England, is published with the aid of the Johns Hopkins University. Vol. IV., in progress. $5 per volume.

A volume of CONTRIBUTIONS TO LOGIC by members of this University was issued in 1883, under the editorial direction of Mr. C. S. Peirce. Price $2.00. Little, Brown & Co., Boston, Publishers.

The University Circulars, Annual Report, and Annual Register will be sent by mail for one dollar per annum.

All communications in respect to these publications should be addressed to the "Publication Agency of the Johns Hopkins University," Baltimore, Maryland.

Johns Hopkins University Circulars.

BALTIMORE, MARCH, 1884.

CURRENT INTELLIGENCE.

COMMEMORATION DAY.

ghth Annual Commemoration Day of the Johns Hopkins Univer-
›bserved with appropriate ceremonies, Friday, February 22, 1884.
ic exercises were held in the Gymnasium at twelve o'clock. At
, a procession entered the building in the following order:

rt: The Marshal and Aids.

Trustees and the Faculty of the Johns Hopkins University, with
iests invited from other Institutions of Learning.

staff of Fellows.

r students of this University who have already taken their first
ıdemic degree.

lidates for the degree of Bachelor of Arts.

ndants upon lectures and other students not candidates for a
gree.

e company of ladies and gentlemen had already assembled. The
decorated with flags and flowers, and with portraits of Johns
(by Le Clear, of New York), and of Professor Sylvester (by
Pennington, of Baltimore).

was offered by Rev. J. T. Leftwich, D. D., of the First Presby-
iurch.

›hns Hopkins Glee Club next sang an ode of Horace: "*Integer
risque purus.*"

ent ELIOT of Harvard University, then delivered a discourse on
gree of Bachelor of Arts as an Evidence of a Liberal Education."
stened to with profound attention and was frequently interrupted
ssions of approbation and interest. An abstract of the address is
The Day, Baltimore, February 22. It will appear in full in
ury Magazine, for June next.

conclusion of the chief address, President Gilman gave some
of the inside work of the Johns Hopkins University, and the
were concluded by the singing of *Gaudeamus*, by the Glee Club.
afternoon the various public rooms were thrown open to visitors,
iundred of whom went through the laboratories and halls. In
ing the officers of the University gave a reception to the students
r friends.

[arshal of the day was Dr. Hartwell, and his Aids were Messrs.
nomas, A. T. Bruce, E. R. L. Gould, L. Riggs, Jr., D. T. Day,
evens, L. Duncan, D. R. Randall, F. M. Warren, and A. Yager.
›llowing members of the Matriculate Society acted as ushers in
nasium: R. H. Bayard, W. B. Canfield, C. H. Howard, R. C.
ı, E. G. Miller, Jr., W. H. Perkins, J. Pleasants, L. Williams,
Williams, and A. C. Woods.

OPENING OF THE NEW BIOLOGICAL LABORATORY.

iew Biological Laboratory was formally opened to the public
day evening, January 2. An address was given in Hopkins Hall
Director, Professor Martin, on "Modern Physiological Labora-
which has been printed in two recent numbers of *Science*. An
of the laboratory and of the address, and of other matters per-
to the study of Biology will be presented in a future number of
rculars.

AWARD OF THE RUMFORD MEDALS.

Rumford Medals of the American Academy of Arts and Sciences
stowed upon Professor H. A. Rowland, at a meeting of the Acad-
ebruary 13, 1884, in recognition of his researches in Light and
A brief account of the terms of the gift of Count Rumford, and a list
ormer recipients of the medals may be found in the *Nation*, New
February 7, 1884. The addresses at the meeting are given in
February 29.

REPORT OF THE MARYLAND OYSTER COMMISSION.

The Oyster Commission of the State of Maryland, appointed by Governor Hamilton, in accordance with an act of the Legislature, to consider the Oyster problem, has presented its report. Dr. W. K. Brooks, Director of the Chesapeake Zoölogical Laboratory, was the chairman of this committee, and the other members were Messrs. J. I. Waddell, and W. H. Legg. Their report has been presented to the Legislature. On account of the scientific character of a part of the report, a limited edition of it has been re-issued with the following preliminary note:—

"A small edition has been printed, for the use of the University, of a Report of the Oyster Commission of the State of Maryland, which has just been presented to the Legislature of this State. Its author is one of our own staff, Professor W. K. Brooks, Ph. D., who has devoted the greater part of his time during the last eighteen months to the study of the problem of perpetuating the oyster beds of the Chesapeake. The fact that he was made a member of the Oyster Commission, by appointment of the Governor of the State, should not conceal the part which this University has taken in the prosecution of the enquiry. Dr. Brooks, for the last six years, has been the Director of the Chesapeake Zoölogical Laboratory, an organization maintained at the expense of the Johns Hopkins University for the study of the manifold forms of living creatures which are found upon our sea-board. As long ago as 1878 he perceived the importance of the oyster, in its economical and in its scientific aspects, and began a series of prolonged, delicate, and original investigations respecting the mode by which the young are propagated, and the conditions of their early life. The discoveries which he made were published in 1879, and have been fundamental to further practical attempts, on the part of Dr. Brooks and others, especially Lieut. Francis Winslow, U. S. N., Mons. Brouchon-Brandeley, of Paris, and Mr. J. A. Ryder, of the United States Fish Commission, to secure the successful artificial propagation of the oyster in large numbers. They have also led to a study of the conditions which destroy the life of young oysters, and of the legislation which is requisite for modifying these conditions.

"The report which follows discusses all these points. Its preparation devolved upon Dr. Brooks, as chairman of the Commission. I am confident that in all he has done or said he has been governed by one consideration alone,—a desire to ascertain the exact facts, and to state them in such a way that others may understand them, and thus be enabled to protect and develop one of the most important industries of Maryland.

"He desires to have it known that the Report is in great part a gift by the University to the people of the State, since it would have been impossible for him to have prepared it if the Trustees of the University had not allowed him to devote a year to the work, while they continued to pay him the salary of his professorship." D. C. G.

MR. WALTERS'S GALLERIES.

For many years past, Mr. William T. Walters, of Baltimore, has been engaged in the collection of works of Art, and he has been accustomed to open his galleries to the public from time to time, with great liberality, under proper restrictions.

Within the last year or two he has built a new gallery, made many new purchases, re-arranged the entire collection, prepared two descriptive manuals, and has again invited the public to examine what he has brought together. On the twenty-sixth of February, a large company of artists, art critics, students of art and other friends of Mr. Walters were present at the re-opening of the galleries. Subsequently under the auspices of the Decorative Art Society, a company of ladies had a similar opportunity. During the months of March and April, the collections will be opened to the public, on the payment of an admission fee, the proceeds of which are to be given to the Association for the Improvement of the Condition of the Poor.

The students of this University, especially those from a distance, are advised to avail themselves of this great privilege. It is safe to say that nowhere in this country is there so good an opportunity to see examples of the work of the best contemporaneous painters,—and that in Oriental Art, especially Chinese and Japanese, Mr. Walters's collection is unequalled.

By the liberality of two or three gentlemen, who consider it to be an important part of a liberal education that every student among us should visit this collection, a certain number of tickets of admission are at the disposal of the President of the Johns Hopkins University, to be given to those who would not otherwise be likely to visit the collections.

Formation of an Archæological Society.

Special attention is to be paid during the current session to the subject of archæology, for the purpose of bringing before the members of this university the importance of this study. A course of Lectures on Classical Archæology is announced on another page. A society has been formed for the voluntary prosecution of studies in this department, the report of which will be found under the proceedings of societies.

The meeting for organization was held on February 9 and the following constitution was adopted:

Art. I. The Society is to be called "The Archæological Society of the Johns Hopkins University."

Art. II. The Society is to consist of twelve active members, and such associate, corresponding, and honorary members as they may elect.

Art. III. The attributions of active members are: to manage the entire business of the Society, and to elect, besides members and officers of their own body, associate, corresponding, and honorary members.

Art. IV. Conditions of membership are as follows: active members are to be such as are actually engaged in the study of archæology or art; associate members are admitted by a majority vote of the active members upon the nomination of an active member.

Art. V. A chairman shall be selected at each meeting of the Society; the permanent officers shall be a recording and a corresponding secretary.

Art. VI. The meetings of the Society are to be periodical at dates fixed by an executive committee as provided in the by-laws. The proceedings are to consist of the reading of papers on ancient and modern art. of reports on discoveries and investigations, and of the examination and discussion of objects of art either in originals or reproductions, and of aesthetic questions.

Art. VII. Corresponding and honorary members will be invited to send in papers to be read before the Society. Gentlemen not members may be invited to read papers.

Art. VIII. The Constitution of the Society may be changed by a two-thirds vote of all the active members.

Art. IX. The Society may acquire property by contribution or gift, and may accept loans of works of art. In the case of the dissolution of the Society, any property it may possess will fall to the University.

Among the preliminary doings of the society, there will be an inquiry into the facilities for archæological study offered by public and private collections in Baltimore, which will be communicated in its meetings; and under the same auspices, Dr. Frothingham offers to members of the University short expositions of the following subjects, copiously illustrated with photographs and art-books: I. The Catacomb frescos; II. The Sculptures of early Christian Sarcophagi; III. Mosaic painting; IV. Ivory carvings; V. Metal Sculpture during the Middle-Ages; VI. Sculpture in France during the Gothic period; VII. The revival of Sculpture in Italy; VIII. The schools of painting in Italy during the XIV and XV centuries.

Addition to the Collection of Minerals.

A collection of minerals, numbering sixteen hundred specimens, which was made by Professor O. D. Allen, of the Sheffield Scientific School, of Yale College, has recently been purchased by this university. It is placed in charge of Dr. G. H. Williams, Associate in Mineralogy, from whom the following statement has been received:—

Professor Allen has been forming the collection during the last twenty years. The specimens are all of small size, but are, without exception, very choice and typical. Nearly all the commoner mineral species are present in specimens from the best known localities, both in this country and Europe, while certain American localities, which Professor Allen explored and, in some cases discovered, are represented by almost unique suites. Among the latter may be mentioned the Tilly Foster Iron Mine, at Brewster, N. Y., for chondrodite; Litchfield, Me., for zircon, cancrinite, etc.; Buckfield, Me., for Muscovite crystals; North Madison, Ct., for beryls; Paris Hebron, Me., for tourmalines; Roxbury, Ct., for pyrite.

In this connection, it may be well to add that the work in Mineralogy for the year 1883-4 has been organized with especial reference to the needs of the more advanced chemical students. The course of lectures includes a treatment of crystallography, crystal drawing, and the modern methods of research in physical mineralogy, full enough to enable a chemist to thoroughly investigate, describe, and figure any crystals of a new substance. It also includes a systematic description of the important natural mineral species, the classification followed being that of Groth's "Tabellärische Uebersicht," 1882. Opportunity is given on Saturday morning to practically apply the methods described in the lectures and also at other times for work with crystallographic, optical, and other mineralogical instruments.

During the last half of the year, the lectures are to be on General Geology, with especial reference to the modern methods of petrographical research.

The Marine Laboratory at Wood's Holl, Mass., established by the United States Fish Commission, under Professor S. F. Baird, Director, will be open for workers during the coming summer. In the initiation of this undertaking, the Johns Hopkins University made a subscription entitling it to nominate annually a student in zoölogy, who may have the right to occupy one of the laboratory tables.

The number of persons who wished to hear the lectures of Professor Corson on English Literature was so large that it far exceeded the capacity of Hopkins Hall. The Trustees of the Peabody Institute courteously gave permission to have the course delivered in one of their halls under the designation of "Peabody Institute Class Lectures." The average attendance has been over three hundred. A schedule of the course is given on p. 45. Professor Corson has also given a series of readings on successive Thursdays in Hopkins Hall.

The course of Educational Lectures (previously announced) to college graduates who are looking forward to the career of teachers, was begun on Saturday, February 16, in the lecture room of the Chemical Laboratory. Tickets were issued to seventy-eight persons connected with the university who expressed a desire to attend.

At the request of the public school authorities of Baltimore, a lecture on Manual Training Schools was given by Professor C. M. Woodward, Director of the Manual Training School, connected with the Washington University, of St. Louis, in Hopkins Hall, Monday, February 4, at 8 p. m.

The Annual Report of the President of the Johns Hopkins University for 1883 is printed and ready for distribution.

The Glee Club, which was formed in the last autumn, gave a public entertainment in Hopkins Hall, Thursday, February 14, at 8.30 p. m. The programme included some classical music and a number of college songs. The singers were:—

First Tenor: F. M. Warren, W. Wilson.
Second Tenor: L. T. Stevens, A. Yager, R. J. Pratt, B. T. Roberts, A. Shaw.
First Bass: R. H. Bayard, B. J. Ramage, D. T. Day.
Second Bass: E. R. L. Gould, J. S. Hodges, C. H. Levermore, J. Page.
The pianist was Mr. E. L Crutchfield.
The vocal instructor of the club has been Mr. L. Odend'hal.

The American Journal of Mathematics, Vol. VI, No. 3, *March*, 1884, contains papers as follows:

On Quadruple Theta-Functions (*continued*). By Thomas Craig.
On certain Groups of Relations satisfied by the Quadruple Theta-Functions. By Thomas Craig.
On the Absolute Classification of Quadratic Loci, and on their Intersections with each other and with Linear Loci. By W. E. Story.
The Imaginary Period in Elliptic Functions. By W. W. Johnson.
Second Note on Weierstrass' Theory of Elliptic Functions. By A. L. Daniels.
Lectures on the Principles of Universal Algebra. By J. J. Sylvester.
Note on the Development of an Algebraic Function. By Capt. P. A. MacMahon, R. A. With a Note thereon by F. Franklin.

Correction. Circular, No. 28, p. 39, col. 2, l. 24, the MS. had the word "slot" instead of "dowel," which found its way into the text from a query of the proof-reader on the margin. A. E.

NOTES AND COMMUNICATIONS.

PHILOLOGY.

The so-called Woman's Language of the Ancient Babylonians. By PAUL HAUPT.

[Abstract of a paper read at the meeting of the University Philological Association, December 7, 1883].

The idiom of the non-Semitic aborigines of Babylonia has come down to us in two dialects. In one of them chiefly magical formulae and incantations are composed, in the other hymns and penitential psalms. The latter dialect is designated by the Assyrian national grammarians in the ancient cuneiform vocabularies *eme-sal*, commonly rendered by "Female Language" or "Woman's Language."

From various indications I reached the conviction (about the end of 1880) that the so-called "Woman's Language" was the dialect of Shumer (the Biblical Shinar) or Lower Babylonia, the other the idiom of Akkad or Upper Babylonia. Almost all Assyriologists accepted my conclusions; a young employé at the Royal Library of Munich, however, who devotes his leisure hours to Assyriology, has since taken occasion to dispute this theory. According to "his novel view", which had been advanced already by Professor A. H. Sayce in 1877, the Woman's Language was not spoken in Sumer but in Akkad or North Babylonia. The main proof which he brings forward in behalf of his assertion is that the names of Upper Babylonian localities are to be found in the hymns and psalms of the Woman's Language. This is indeed true, but I think that the connection in which those geographical names occur is of some little consequence. I have collected all the passages in which the names of cities, temples, rivers, and mountains are to be met with in the Sumero-Akkadian texts, and if they are considered attentively in the light of the context, the enthusiasm for the "ebenso scharfsinnige wie glückliche Beweisführung" (Lit. Centralbl. 1883, col. 618) will be sobered a little. When at the end of a litany in the "Woman's Language" Bel of Nippur, Merodach of Babylon, and other local deities of Upper Babylonian cities are invoked, this proves as little for the place where the text in question was composed as does the mention of Apollo of Delphi in a Greek inscription. And when we find in the exorcisms and magical formulae on almost every page a reference to the atoning sprinkling of Eridu, the centre of the cultus of *Ea*, the θεὸς ἀποτρόπαιος, the deus averruncus κατ' ἐξοχήν, or the invocation of Ea's ever helpful son Merodach as *tur-Urudugá-kid*, "son of Eridu," I fail to see how one can imagine this an irrefragable proof that all these texts were composed in the neighborhood of Eridu (the present *Aboo-Shahrein*) in South-Babylonia, and therefore written in the Sumerian dialect. Even if it could be proved that the monuments excavated at Tell-Loh by the French vice-consul in Basra, Monsieur E. de Sarzec, do not show the characteristic phonetic deviations of the *eme-sal* texts, it would not induce me to abandon my well founded views. It might be useful to bear in mind my remarks at the bottom of page 2 of my *Akkadische Sprache* (Berlin, 1883, Asher & Co.)

I may be allowed to add that I intend to publish in one of the early numbers of the University Circulars some critical observations about the text of my *Keilschrifttexte* and my edition of the Nimrod epic just issued (Leipzig, Hinrichs). I shall also try to show that the Assyrian Aleph in words like *ômu* "day," or *arxu* "month," may be more primitive than the *y* and *w* in the Arabic *yôm*, or in the Ethiopic *warx*. I may likewise mention beforehand, that the Syriac *'seladdâ* really is the Assyrian *'salamtu* "corpse" (fem. of *'salmu*). which was pronounced *'salandu* (cf. the Mandaic form) according to *Familiengesetze* 48, 2; that the Assyrian equivalent of the Akkadian *amar: bûru*, or rather *pûru*, is the masculine to *pûrtu* "juvenca", corresponding to the Hebrew *par*, (see Nimrod epic, p. 51, l. 7 and 8); that the "ideograph" for ὁ, ἡ δεῖνα (No. 274 of Delitzsch's *Schrifttafel*) is to be read phonetically *pulpul*, a reduplicated form of the Arabic *fulu*, which occurs in poetry instead of the common *fulân*, Hebrew *pelônî*, Syriac *pelân*; and that the Hebrew חתה in the well-known passage, Proverbs, 25, 22, כי גחלים אתה חֹתה על־ראשו, in spite of the *σωρεύσεις*, Romans, 12, 20, is the Ethiopic *xaláwa*, II, 1 *axláwa* "accendit" (cf. the derived noun מחתה).

I hope also to have my Assyrian grammar ready for publication by the fall of this year.

Lucianea. By B. L. GILDERSLEEVE.

CHARON 1. *σὺ μὲν ῥέγκεις, ἐπὶ τοῦ καταστρώματος ἐκταθείς.* The ancients were quick to seize the faintest Homeric allusion—and here there is a clear reference to Odysseus. Xen. An. 5. 1, 2: *ἐπιθυμῶ πλεῖν τὸ λοιπὸν καὶ ἐκταθεὶς ὥσπερ 'Οδυσσεὺς καθεύδων ἀφικέσθαι εἰς τὴν 'Ελλάδα.* Lucian was distinctly thinking of the passage in Xenophon as Xenophon was thinking of Homer (Od. 13, 92). His range of reading was not as wide as has been fancied.

6. *κεραμὶς ἐπιπεσοῦσα—ἀπέκτεινεν αὐτόν*: In his Sittengeschichte, 1, 25, Friedländer, discussing the dangers of the Roman streets, has nothing better to cite than the well-worn exaggeration of Juv. 3, 271, which by its very violence fails to produce the same effect as Epictet. Diss., 2, 6, 17: *τὸ δὲ φθεῖρον ἢ μάχαιρά ἐστιν ἢ τροχὸς ἢ θάλασσα ἢ κεραμὶς ἢ τύραννος.* In French, *tuile* (Comprenez-vous une *tuile* pareille quand on se croit à l'abri de toute littérature? Merimée, Lettres à une inconnue) retains something of the fatefulness of *κεραμίς*.

ADVERSUS INDOCTUM: Did Sebastian Brant know Greek or if he did, had he any access to Lucian? There seems to be little likelihood of either, though he was a friend of the great Hellenist Reuchlin. Yet a droll coincidence may be worth noting: cf. c. 4: *καὶ σὺ τοίνυν βιβλίον μὲν ἔχεις ἐν τῇ χειρὶ καὶ ἀναγινώσκεις ἀεί, τῶν δὲ ἀναγινωσκομένων οἶσθα οὐδέν, ἀλλ' ὄνος λύρας ἀκούεις κινῶν τὰ ὦτα*

von büchern hab' ich grossen hort
verstant doch drin gar wenig wort

. . . .

die oren sint verborgen mir
man säh sunst eines mullers tier.

c. 1: *φθάνοντος τοῦ ὀφθαλμοῦ τὸ στόμα*: d. i. zerstreut, ohne Theilnahme und Verständniss indem das Auge und mit ihm der Blick wo anders weilt als der lesende Mund (Sommerbrodt). Whether the ancients read every good book aloud, as Wieland says, or not, reading aloud to one's self was doubtless more common, as reading was certainly more difficult than it is now. Imperfectly educated persons are often unable to read without at least forming the sounds with the mouth and occasionally educated persons retain the bad habit of moving the lips while reading. Here, I think, we have "impatience" rather than "ignorance." Fuller confesses somewhere that when he read a chapter in the Bible that did not end on the page, he could not help turning over to see how long it was and a similar impatience is noted in Martial, 2, 6, 1–3:

I nunc edere me iube libellos.
lectis vix tibi paginis duabus
spectas eschatocollion, Severe.

BIS ACCUSATUS, 28: *καὶ οὐκ αἰσχύνεται τὴν μὲν ἐλευθερίαν καὶ τὸ ἄνετον τῶν ἐν ἐμοὶ λόγων συντεμών, ἐς μικρὰ δὲ καὶ κομματικὰ ἐρωτήματα κατακλείσας ἑαυτὸν καὶ ἀντὶ τοῦ λέγειν ὅ τι βούλεται μεγάλῃ τῇ φωνῇ βραχεῖς τινας λόγους ἀναπλέκων καὶ συλλαβίζων.* This assault made by Rhetoric on Lucian for going over to Dialogue has some interesting parallelisms with Fronto's protest against Marcus's desertion of oratory, ad Marc. Ant. de eloq., p. 146 (Naber):

Discere te autem ceratinas et soritas et pseudomenus *verba contorta et fidicularia*, neglegere vero cultum orationis et gravitatem et maiestatem et gratiam et nitorem, hoc indicat loqui te quam eloqui malle (*ἀντὶ τοῦ λέγειν μεγάλῃ τῇ φωνῇ*) murmurare potius et friguttire quam clangere. Cf. Apul. Apol., p. 336: audivisti privignum meum vix singulas syllabas frigultientem (*συλλαβίζοντα*). However we may interpret *ἀναπλέκειν*, whether it mean simply "to string" (Pisc. 6) or is to be explained by Fronto's "verba contorta et fidicularia", the whole passage is interesting as carrying out the vituperation of *βραχεῖς τινας λόγους*—"ut si in natando, si aeque liceret, ranam potius quam delphinos aemulari malles, coturnicum potius pinnis *breviculis* quam aquilarum maiestate volitare."

DE MORTE PEREGRINI, 6: Some have seen in *ὀρφανοὺς ἡμᾶς καταλιπών* a reference to our Saviour! cf. Jo. 14, 18: *οὐκ ἀφήσω ὑμᾶς ὀρφανούς.* Kühn combats this position, but has nothing very cogent to adduce. How utterly absurd such a disputation to any one who remembers Plat. Phaedo, 116 A: *ἡγούμενοι—διάξειν ὀρφανοὶ τὸν ἔπειτα βίον!*

Rhetorum Praeceptor, 1: *ἱερόν τι χρῆμα τὴν συμβουλὴν οὖσαν* nach dem griechischen Komiker Menander [Mon. 256]: *ἱερὸν ἀληθῶς ἐστιν ἡ συμβουλία* (Sommerbrodt). That is the easy way in which notes on school editions are made. S. surely could not have forgotten his Xen. Anab., 5, 6, 4: *αὕτη γὰρ ἡ ἱερὰ συμβουλὴ λεγομένη εἶναι δοκεῖ μοι παρεῖναι.* There is no estimating the age of such a proverb, and there is no necessity of saying that Lucian took it from the *Greek* comic poet. Zenobius, 4, 40, attributes it with as little reason to Epicharmus.

Nigrinus. In an article which I wrote on Lucian (Southern Review, October, 1869, p. 397), I said of the Nigrinus: "One thing in this dialogue deserves special notice for its psychological truth. Lucian speaks of his almost ecstatic emotion at the revelation of Nigrinus; and no religious enthusiast could have had more copious sweats, more faltering a tongue, more abundant tears. Then follow, in due succession, rapturous joy, spiritual elevation, tranquil happiness. The negative intoxicates as well as the positive; and many a man has felt as blissful when he was annihilating 'shams' and exploding 'windbags,' as if he had risen to a new life and was revelling in a new creation."

Some years after writing this I noticed a curious parallel between the effect which Musonius (ap. Gell., N. A., 5, 1) said the discourse of a true philosopher should have, and the account in Lucian or Pseudo-Lucian of the effect which the discourse of Nigrinus had on him. This parallel extends even to minutiae. So the same passage of Homer, Od., 11, 333, is cited to which Lucian alludes. The more one reads the literature of this period, the more "stencilly"—to borrow a German expression—does it appear. The outlines are the same everywhere. The difference lies chiefly in the color of the paint.

35. *ἐγὼ δὲ τέως μὲν ἤκουον αὐτοῦ τεθηπὼς καὶ μὴ σιωπήσῃ πεφοβημένος. ἐπειδὴ δὲ ἐπαύσατο, τοῦτο δὴ τὸ τῶν Φαιήκων πάθος ἐπεπόνθειν· πολὺν γὰρ δὴ χρόνον ἐς αὐτὸν ἀπέβλεπον κεκηλημένος.* εἶτα πολλῇ συγχύσει καὶ ἰλίγγῳ κατειλημμένος τοῦτο μὲν ἱδρῶτι κατερρεόμην, τοῦτο δὲ φθέγξασθαι βουλόμενος ἐξέπιπτόν τι καὶ ἀνεκοπτόμην καὶ τέλος ἐδάκρυον ἀπορούμενος. οὐ γὰρ ἐξ ἐπιπολῆς οὐδ' ὡς ἔτυχεν ἡμῶν ὁ λόγος καθίκετο κτέ.*

This is evidently a cruel exaggeration of the orthodox attitude of the true seeker, as given by Musonius: Animus audienti philosophum, cum quae dicuntur utilia ac salubria sunt et errorum atque vitiorum medicinas ferunt, laxamentum atque otium prolixe profuseque laudandi non habet. Quisquis ille est, qui audit, nisi ille est plane deperditus, inter ipsam philosophi orationem et perhorrescat necesse est et pudeat tacitus et paeniteat et gaudeat et admiretur. And then he goes on to show that silence is the truest compliment, as witness the Phaeacians, *ὡς φάτο· τοὶ δ' ἄρα πάντες ἀκὴν ἐγένοντο σιωπῇ.* The reader of Tacitus (Hist. 3, 81) will remember that Musonius did not find fit audience for his "intempestiva sapientia" when he tried Antonius Primus.

26. *ἀγρὸν οὐ πόρρω τῆς πόλεως κεκτημένος οὐδὲ ἐπιβῆναι αὐτοῦ πολλῶν ἐτῶν ἠξίωσεν ἀλλ' οὐδὲ τὴν ἀρχὴν αὐτοῦ εἶναι διωμολόγει.* Comp. for a similar affectation Trimalchio in Petron. c. 48: deorum beneficio non emo (vinum) sed nunc quicquid ad salivam facit, in suburbano nascitur eo, quod ego non novi.

De Merc. Conductis, 34: Boissier says of Fronto, "un assez méchant écrivain mais un fort honnête homme." I will not undertake to discuss Fronto's character here. Marcus tells that he learned from him that *οἱ καλούμενοι οὗτοι παρ' ἡμῖν εὐπατρίδαι ἀστοργότεροί πως εἰσιν* (1, 11), with which we may compare Fronto's own words (ad Ver. Imp. 2, 7): *φιλοστοργία* nescio an Romana: quippe qui nihil minus in tota mea vita Romae repperi quam hominem sincere *φιλόστοργον*; ut putem, quia reapse nemo est Romae *φιλόστοργος* ne nomen quidem huic virtuti esse Romanum. So again, (ad Amicos, 1, 3): probus, philostorgos, cuius rei apud Romanos nomen nullum est. So there is nothing that corresponds to "gemüthlich" in English, and to be "gemüthlich" one must be Teutonic by nature or by training. It is evident that the Romans recognized the fact that *φιλοστοργία* was not a national virtue, and hence it is a happy stroke when the Roman lady in the "Hireling Philosophers" wants a kindly service done to her and to her fellow-creature she calls on her Greek tutor: *δέομαί σου τοῦτο, ἔφη, χρηστὸν ὁρῶσά σε καὶ ἐπιμελῆ καὶ φιλόστοργον.*

On an edition, proposed by the writer, of the Kāuçika-sūtra of the Atharva-Veda. (*Position of the text in the literature;—contents;—materials for the edition*). By Maurice Bloomfield.

Sūtras are short schematic sentences, which offer the doctrines of a certain science in a shape most easily remembered. The language is generally Vedic, but stands nearer to classical Sanskrit than that of the *brāhmaṇas* and *mantras*. The ritualistic sūtras are of a two-fold character: 1. *Kalpa* or *çrāuta-sūtras*, treating the large sacrifices for which three fires and many priests are necessary; these attach themselves very closely to the brāhmaṇas. 2. *Smārta-sūtras*, giving traditional prescriptions about religious duties, house customs and the relation of man to man. These are much less directly dependent upon the preceding period, but are largely based upon traditions prior to the brāhmaṇa literature. These smārta-sūtras again are divided into two categories, *gṛhya-sūtras* 'religious dictates for house life' and *dharma-sūtras* 'law-sūtras', treating of the relations of men in social, civic, and political life.

Of these the *gṛhya-sūtras* concern us here. The number of these texts actually preserved or known to Indian tradition is not large. Belonging to the Rig-Veda we have:

1. The *Āçvalāyana* (-gṛhya-sūtra); edited by Stenzler in text and translation, Leipzig, 1864–5.

2. The *Çānkhāyana* or *Kāuṣītakin*; edited by Oldenberg in text and translation, Indische Studien XV, Berlin, 1878.

3. The *Çāmbavya*, coming from a school closely related to the preceding (the *Kāuṣītakin*); see Indische Studien XV, p. 4.

To the Sāma-Veda belong:

4. The *gṛhya-sūtra* of *Gobhila*; edited in the Bibliotheka Indica by Candrakānta Tarkālaṅkāra, Calcutta, 1880.

5. The *Drāhyāyaṇa-gṛhya*-sūtra of *Khādira*, found by Burnell and reported in his Catalogue of South-Indian MSS., p. 56.

To the White Yajur-Veda belong:

6. The *gṛhya-sūtra* of *Pāraskara*; edited and translated by Stenzler, Leipzig, 1876–8.

To the various schools of the Black Yajur-Veda belong:

7. The *Āpastamba*; materials for an edition in the possession of Prof. Garbe of Königsberg.

8. *Bāuddhāyana*, unedited; a MS. is contained in the collection of Fort William; another in Munich (Verzeichniss der orientalischen Handschriften des Prof. Dr. Martin Haug, Nr. 162).

9. *Bhāradvāja*, Burnell, Catalogue of South-Indian MSS., p. 30–33.

10. *Hiraṇyakeçin*, Bühler, a Catalogue of MSS. from Gujerat, Part I, Nr. 312.

11. The *Kāṭhaka-gṛhya-sūtra* of Lāugākṣi; see Jolly, Das Dharmasūtra des Viṣṇu und das Kaṭhakagṛhyasūtra, Transactions of the Bavarian Academy for 1879.

12. The *Mānava-gṛhya-sūtra*, see P. von Bradke in the Journ. of the Germ. Oriental Society, XXXVI, p. 417 fgg.

Of the Atharva-Veda we have one sūtra which is partially a gṛhya-sūtra:

13. The *Kāuçika-sūtra*, which I propose to edit for the first time.

The Atharva-Veda shares the characteristics of the other Vedas as far as the division into *çākhās* or schools is concerned. Tradition reports nine Atharva-schools, five of which are pretty well authenticated. The saṅhitās or hymn collections of two of them have been found. One is the collection of the *Çāunaka* school, which was edited by Roth and Whitney (Berlin, 1856). The discovery in Kashmir of a second important school, probably the *Pāippalāda*, differing considerably from the *Çāunaka* version is due to the ingenuity and influence of Roth, and I saw in the summer of 1882 the unique birch-bark MS. of this text which Roth holds in Tuebingen (see Der Atharva-Veda in Kaschmir, a programme of the University of Tuebingen, 1875; also Roth in the Transactions of the Fourth International Congress of Orientalists). In its subdivision into schools the AV. accordingly stands on a level with the other Vedas. But its doubtful canonicity begins to appear as soon as we look about among the brāhmaṇas and sūtras which these nine or five çākhās ought to have developed. The meaning of the fact that the earliest literature recognizes only a three-fold veda, a *trayî vidyā* here becomes apparent. The Atharva-schools at first were not orthodox, and were therefore not in the condition to develop the same kind of a religious literature as the other schools. Thus the schools of this Veda have practically no brâhmaṇas; for the single Gopatha-brâhmana is patently a later production. This non-canonicity seems to have had a still more striking effect on the sûtras, for here also the constant relations of the sûtras to the hymn-collections of the school are much disturbed. There is a çrâuta-sûtra of the AV. called *Vâitâna-sûtra* (edited and translated by Garbe, 1878), and it belongs apparently to the *Çâunaka*-school, but its very small size and its lack of originality at once challenge the same criticism as the single brâhmaṇa. It is also late and perhaps an imitation of the literary conditions of the other *çâkhâs*. Originally, *i. e.*, before its admission into the canon, the AV. probably had no large Vedic ceremonial; for which many priests of the other Vedas were needed. But in compensation for that, the private life and the private performance of ritualistic acts by one who adhered to this Veda of incantation, exorcisms, etc., must have been very extensive, bringing in much which was unknown in other schools, and to this the largest, and by far the most important accessory text of the AV., the *Kâuçika-sûtra* owes its peculiar character. This may be best described by stating that the *Kâuçika* performs a double function, (1) that of a *gṛhya-sûtra* in the sense of the other schools, (2) as a special *Atharvaṇa-sûtra*, *i. e.*, a book giving in systematic sûtra form those lower performances of private life, which are peculiar to this Veda. In accordance with its double function is its size; it is about 2½-3 times as large as a common *gṛhya-sûtra* and contains from 1700–1800 *çlokas*, blocks of 32 syllables, which are employed by the Hindus as units of measurement for manuscripts. This text also belongs to the Çâunaka-school, and brings in the most checkered manner common house-rites and Atharvanic rites amalgamating the two in a very thorough manner.

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*Copied from Plat. Protag., 328-D: *καὶ ἐγὼ ἐπὶ μὲν πολὺν χρόνον κεκηλημένος ἔτι πρὸς αὐτὸν ἔβλεπον.*

The text is divided into fourteen books, the chief contents of which are as follows:

I. The new and full-moon sacrifice; *sthâlîpâka*, the common offering of cooked rice on the occasion of the smaller sacrifices; *gaṇas* or strings of hymns and verses from the AV. which are supposed to have certain magical effects, such as scaring away demons, purifying, removing danger, etc.

II. The rite for begetting wisdom in a child; obtaining success in the vow of chastity; the acquisition of all sorts of desirable property; rites for producing success in wars and battles; restoration of a dethroned king; coronation.

III. The rites to *Nirṛti*, the goddess of mishap; feeding and fattening of cattle; the acquisition of power and prosperity; inauguration of a new hall; the *vṛṣotsarga*, a ceremony by which a young bull is given over to a certain community as a breeder.

IV. The fourth book consists of two distinct parts: (*a*) bhâiṣajyâni, remedial rites for all possible diseases, (*b*) strî-karmâṇi 'rites pertaining to women; charms; philtres; rites for regaining lost affection; rites against jealousy, etc.

V. Expedients for finding out whether a certain act or step be good or bad; the warding off of storms, lightning, and excessive rain; charm for forensic successes, in disputation and arbitration; charms to make rivers flow according to one's wishes; success in treasure-digging, in gambling, in trade; rites for entering a new house; purification of a house.

VI. Rites for bewitching and for the destruction of rivals.

VII. *Saṅskâras*, sacramental rites in the life of the young brahmanical Indian: giving of a name; first food; *cûḍakaraṇa*, the preparation of the tribal hair-lock; *godâna*, preparation of the hair previous to investiture; the *upanayana*, or investiture with the sacred cord, by which the young Indian becomes 'twice-born,' a member of the religious community; *kâmyeṣṭis*, ad hoc prayers for the fulfilment of a certain wish.

VIII. *Sava*, *pañcâudanâ*, *çatâudanâ*, *odanasava*, preparation of feasts for the brahmans as reward for service rendered in sacrificial performances.

IX. The preparation of the sacrificial fire; morning and evening-libations; the *vâiçavdevaṁ*, offerings to all divinities and beings; the offering of first fruit.

X. The marriage ceremony.

XI. *Çrâddhas*: various oblations to the spirits of deceased ancestors (*pitṛmedha piṇḍapitṛyajña, etc.*)

XII. The *argha* ceremony, with which honored guests especially bridegrooms are received; *madhuparka*, the drink of honey, curds, etc., which is offered at the reception.

XIII. The warding off of evil effects of all kinds of *omina* and *portenta*, unusual natural occurences, etc.

XIV. The *âjyatantra*, the preparation of the sacrificial butter; *bhûsaṁskâras*, preparation of the sacrificial ground; *aṣṭakâs*, sacrificial performances on the eighth day after the full-moon of certain months: Veda-study and intermissions in the same; *indramahotsava*, a festival by which kings obtain firmness of sway.

In the summer of 1882 I went abroad, largely for the purpose of collecting materials for an edition of the Kâuçika. Of this text there existed in Europe for a long time only a single fairly correct MS., No. 119 of the Chambers collection in the Royal Library at Berlin, catalogued by Weber, *Verzeichniss der Sanskrit-Handschriften*, p. 88 (cf. *Indische Literaturgeschichte*, 2d ed., p. 168). The date of this MS. is *sa''vat* 1670, and a copy of it belonging to Prof. Whitney, and now in my possession, was the material I started out with.

In 1871, Prof. Roth obtained through Prof. Kielhorn's mediation a copy of a Kâuçika MS., of Elphinstone College, of late date (*çake* 1792), and of inferior value. It seems to stand in some genetic relation to the Chambers MS., as it shares many readings and blunders with the latter.

In 1874, Roth finished a collation of a MS., of the Pûna Deccan College, which had been sent to him by the Bombay government (cf. his *Atharva-Veda in Kaschmir*, pp. 13, 24); it is dated *saṁvat* 1740, *çake* 1606. This contains many better readings than the Chambers and Elphinstone MSS., and is perhaps a copy of, certainly in some way related to, a MS. dated *saṁvat* 1708, which I now have in my hands, and which will be mentioned below.

In 1878, Roth collated a MS. from Bikanîr dated *saṁvat* 1735; also a very fair MS.

Upon my arrival in Tübingen, Prof. Roth kindly allowed me to use his materials, and I had thus four readings of the text. But with all of them an even approximately correct edition would not have been possible; and I turned to India for help. I addressed myself to Mr. K. M. Chatfield, the Director of Public Instruction, who responded by sending for me last summer to the India House thirteen MSS., two of the Kâuçika itself, and eleven small texts belonging to the Atharva-Veda in general. Dr. Rost at once sent them to Baltimore, and they are now in my possession.

The most valuable of these MSS. is a very excellent text of the Kâuçika, older than any previously known in Europe. It is No. 86 of the paper MSS. catalogued in Kielhorn's report to the Director of Public Instruction for the years 1880–1; written *samvat* 1708, therefore 280 years old, and in an excellent state of preservation. This MS. seems to be the source of the Pûna Deccan College MS. mentioned above, and is as far as I have been able to find out, the oldest codex of the Kâuçika which has as yet been catalogued or noticed.

The other Kâuçika-text which I owe to the liberality of the Indian goverment is of inferior value. It is MS. No. 150 of the collection of 1879–80, and a quite modern copy, corrected only in the first few *kaṇḍikās*.

Of the eleven small Atharva-texts, all but one are of subordinate value for the work in hand, though a few passages in the Kâuçika are benefited by one or the other of them.

This one has the title: *daça karmâṇi brahmavedoktâni*, and is nothing else than a *paddhati* to those parts of the Kâuçika, which treat what is strictly house-ritual. It begins with the *âjyatantra*, which is an amplification of the first *kandikā* of the 14th book of the Kâuçika, and then turns to the *saṁskâras*, from the *garbhâdhânam* to the *caturthîkarma*. On the other hand, those parts of the Kâuçika which are especially Atharvanic in their character it does not touch upon at any point.

By far the most important factor in the edition is the fragmentary commentary to the Kâuçika by Dârila. My knowledge of the existence of this commentary is due to a correspondence with Prof. Weber, carried on in the summer of 1882; the text is part of a codex of Atharva-writings presented to the Royal Library at Berlin by Prof. Eggeling. The title is *kâuçika-bhâṣya*, by Dârila-bhaṭṭa, the grandson of Vatsaçarman; it goes to the end of the second *kaṇḍikâ* of the 6th *adhyâya*. The text is treated as though fairly at an end, at least as far as the immediate source of this copy is concerned, for we have a colophon at the end, with the date *çake* 1762. Of Dârila I have found no mention anywhere else, but '*pâdas of* the teacher Vatsaçarman' (*pādā upādhyāyavatsaçarmaṇaḥ*) are cited in Dārila's comment. As the MS. was under no conditions to be removed from Berlin, I had to get a copy (in devanāgarī); and in this I was kindly aided by Dr. Klatt, the custos of the Indian Department at the library.

The MS. of this text is very corrupt, and the comment often very obscure; yet I may fairly say that it forms the most valuable single factor in my materials. The MSS. of the text alone rarely divide the *sūtras*, and that is the chief difficulty in the more obscure parts of the text. For this, and of course also for the exegesis of many difficult passages, it has been very useful. It contains the explanations of a considerable number of Kāuçika-words whose meaning has been either entirely unknown or m sunderstood. The additions and emendations to the lexicon will amount to about 150.

The work of establishing the text is now so far advanced, that I may expect to have the first part, containing text, list of mantras, and an index of all important words ready for print in the course of 1884. I shall then proceed at once to a second part, containing the translation, with commentary and an introduction.

Stichometry and the Vatican Codex B. By J. Rendel Harris.

In a letter dated October 21 of last year, Prof. Nestle, of Ulm, communicated to me with great courtesy his observations of the partial stichometry of the Vatican Codex, and as this discovery of the verse-marks for successive hundreds on the margins of the MS. completely confirms my speculation that the line of Codex B was a half-hexameter, I take the opportunity of academically expressing my thanks to Dr. Nestle for his interesting information. The marks to which he draws attention are found in the four books of Kings and in Isaiah; where they run as follows: in i Kings from 100 to 800; ii Kings from 100 to 2300; iii Kings from 100 to 2800; iv Kings to 2300; and Isaiah to 3500.

The interval between successive hundreds is generally somewhat over 200 lines of the Vatican Codex, the average for the first of Kings being 220 lines; this indicates either as Dr. Nestle suggests that the MS. in this book was taken from a copy whose lines were a little over the compass of two Vatican lines; or, as I should content myself with saying, that they were measured by a standard line of just such a length as has been indicated; according to a previous remark of mine that the line of the Vatican Codex is a somewhat curtate half-hexameter.

Those who wish to study the stichometry of these parts of the Vatican MS. will find the numbers recorded intelligently enough as *numeri centenarii*, in the appendices to the great Roman edition of B.

These numbers are interesting to the paleographer on account of the curious symbols which they employ for 1,000, 2,000, 3,000 in place of the customary ͵α, ͵β, ͵γ. For 900 an inverted arrow-head or anchor is used, but this form I find noted in Gardthausen, Palæographie, p. 266. The others I do not remember to have met with. It might seem at first sight that these new data would enable us to decide definitely between the two hypotheses of a line containing a given number (16) of syllables, and a line containing a given number of letters (36). This point I have not yet been able to settle with satisfaction: the first hundred verses in i Kings consists of about 1,656 syllables which seems to intimate that the reckoning was not made in strict 16-syllable rhythms, on the other hand from ψ to χ in Isaiah by actual count in the codex itself was found to be 101 sixteen-syllabled hexameters which is a very close equivalence.

It will sometimes be found, especially in the books of Kings, that the reckoning for special hundreds is wide of truth, and from an apparent method in the error, it seems as if the original count had been made twice over on some parts of the book, or on some of the original pages from which the book was reduced, or that some column or page has been missed; and in one or two instances the mark has been misplaced, which will not, however, affect the average result.

For the convenience of students of this somewhat out-of-the-way subject, I subjoin the references for the successive hundreds of stichi in Codex B, as given by the editors for the first book of Kings; remarking in so doing that in order to calculate the number of lines it is necessary to remember (what is not stated by Scrivener in his description of the codex) that it is by no means true that the manuscript always contains forty-two lines to the column. The following are my observations which agree closely with Dr. Nestle's results:

	Page.	Col.	Line.		Lines of B.
1 *Reg.* begins	309 .	2 .	1		
100 στίχοι	311 .	1 .	7	=	227
200	312 .	3 .	2	=	215
300	314 .	2 .	14	=	227
400	316 .	1 .	11	=	217
500	317 .	3 .	12	=	221
600	319 .	2 .	8	=	216
700	321 .	1 .	6	=	218
800	322 .	3 .	6	=	220

ceteræ desunt.

Average for 100 verses in 1 Reg. = 220 lines of B. The figures for the remaining books are reserved for a separate discussion.

Notes on the Sinaitic and Vatican Codices. By J. Rendel Harris.

[Abstract of a paper read at a meeting of the University Philological Association, January 7, 1884].

This paper contained a summary of the results of some recent investigations made in the two oldest MSS. of the Bible.

1. Some inaccuracies were pointed out in the common descriptions of the two MSS. with regard to the arrangement of the lines of the text.

2. An enquiry was made as to the probable contents of the six missing leaves of the Codex Sinaiticus between the epistle of Barnabas and the Shepherd of Hermas. Some errors and inconsistencies were pointed out in Scrivener's Introduction to the New Testament in the account given of the missing leaves and their probable text.

From the fact that a column is left blank at the end of Barnabas and that Hermas begins on the first leaf of a new quaternion, it was inferred that the lost writing was of the kind known as στιχηρῶς, similar to that found in the poetical books of the Old Testament.

A calculation was then made of the space that would be occupied by the Psalms of Solomon written after the manner of the ordinary Psalter; and it was found that these Psalms which are equal to about 670 hexameter verses, would nearly fill the twelve missing pages. It was, therefore, inferred that they originally stood in Cod. Sinaiticus, as they are known to have done in Cod. Alexandrinus.

3. A careful analysis was made of the Ancient Chapter-Divisions in the Acts of the Apostles. The 36 lections exhibited by Codex B were shown to exist also with slight variations, in Euthalius' edition of the Acts: attention has already been drawn to this by Prof. Ezra Abbot in the Prolegomena to Tischendorf, N. T. (ed. viii). There seems to be evidence for connecting these chapter-divisions with Pamphilus and the library at Cæsarea.

The longer chapter-divisions which are found in both the MSS. and which also occur (as Dr. Hort points out, Introduction, § 349) in Cod. Amiatinus, were next discussed

The Vatican MS. was shown to have missed at least one chapter in the process of numeration, and the Sinaitic MS. apparently desisted from numbering beyond the folio in which the disagreement with Cod. B occurs. The whole division was shown to be one of at least 72 chapters, being probably a duplication of the earlier system.

4. Some speculations were then made as to the place and time of production of the two MSS. Stress was laid upon points of contact of B and Euthalius, and Euthalius and the Pamphilian library; between B and Sinaiticus, and Sinaiticus and the same library; and by an examination of an assumed instance of subjectivity on the part of the Scribe of the Sinaitic Codex (Matt. xiii, 54, εἰς τὴν πατρίδα changed into εἰς τὴν 'Αντιπατρίδα) it was inferred that both of these MSS. were written in the library of Pamphilus at Cæsarea.

Note on the Early Stichometric MSS. By J. RENDEL HARRIS.

The more this question of stichometry is studied, the more evident does it become that the early MS.-form did not diverge far from the stichometric form in which each line represents the unit of measurement. For this form shows itself, not only in the Vatican Codex, and in process of degradation in Codex C, (whose lines average a hexameter in many pages) but in a variety of other MSS., Biblical and otherwise.

1. For example, in Mnemosyne x. p. 401, Cobet discusses the merits of the MSS. of Herodotus, and vindicates the superiority of Codex R (of the Vatican Library); he demonstrates that the errors of this MS. are mainly transcriptional, such as the omission of whole lines, &c., and by an examination of those dropped lines proves that R was copied from an exemplar which was written in lines containing 15–18 letters. That is, as we should say, written in half-hexameters. Cobet's conclusion is simply this: "In antiquo libro, unde R profectus est, versus erant litterarum 15–18.

2. The Clarendon Press has just issued, under the editorship of Mr. John Wordsworth, a transcription of the celebrated Old-Latin Bible-text known in the critical apparatus of the New Testament as g_1; (Codex Sangermanensis primus). Upon p. ix of his prolegomena the editor remarks, "there are on an average 37–38 letters to a line." I shall have more to say with regard to this edition at a later date, and so content myself with remarking that the MS. is written in average hexameters; (M. Graux gave the average hexameter between 37 and 38 letters).

3. In the Itala Fragments published some time since by Zeigler, (and which are especially interesting as being the earliest MS. authority for the text of the Three Heavenly Witnesses), the editor remarks that his MS. is written in lines which average 36 letters. Here again is the unrecognized hexameter; and, by-the-by, although the version is stichometric, yet the old Greek reckoning is preserved, and at the close of 1 John we find 274 verses numbered in rubric. So that a separate count was not made for the new version.

4. In the treatise of Theophilus against Autolycus, which is a second century work, we find that Theophilus has occasion to quote large sections of Genesis from the LXX; and it has been pointed out by Lagarde in his edition of the LXX, that either Theophilus or his copyists (L. says the latter) have dropped a line of the text in copying the first chapter of Genesis. The note of the editor is as follows: "Usque ad capitis secundi comma 3 exscripsit Theophilus ad Autolycum *β* 11, cujus librarii stichum unum qui est 3 *καὶ ἐγένετο* . . . 4 *καλόν* incuria omiserunt." The omitted words are *καὶ ἐγένετο φῶς. καὶ εἶδεν ὁ θεὸς τὸ φῶς ὅτι καλόν.* Whether we abbreviate the word *θεός* or not, it is evident that this dropped line is a hexameter, being 37 or 39 letters. It appears, therefore, that antiquity when carefully interrogated affirms the stichometric form to have been largely employed. Other illustrations will no doubt present themselves in confirmation of this statement.

The Development of Verbal Parasynthetics in *-a* in the Romance Languages. By A. M. ELLIOTT.

[Abstract of a paper read at the meeting of the University Philological Association, December 7, 1883].

The object of this paper was to show the origin, growth, and tendency to decay of the Parasynthetic compounds in the Romance verb system. The relational *a-* forms were especially considered as faithful types of the whole class, and their existence was attributed in the outset to the disappearance of a special grammar category representing the causal notion in the early stages of Indo-Germanic speech. They are all factitives: they are drawn exclusively from the nomen-series, and are assigned to one of two conjugational schemes (I or II) according as they contain more particularly the active idea, or drift towards the absolute state as designated by the neuter. In their creation, we have a conscious effort to save the more forcible signification of the original verb-root (which signification was lost, so far as any external sign was concerned, in the tendency to the levelling process) by stamping it with a distinctive mark of causality in conformity with the analytic state of the language. They are original in their mode of production, but follow the strict lines of tradition in their functions. A further reason for this special development was found in that other important element in the production of analytic speech, viz: the strong tendency to gain strength by lengthening the form. In their distribution and in their assignment to conjugational types, we note that the representative of the old Sanskrit causal class has incorporated most of them among its original members, some of which had already lost their primitive estate, while others continued to live on beside their ancestors of the Latin II conj., *e. g. sedare* (*sedere*), *clarare* (Old Latin *clarere*). This is especially true of the substantival compounds, few of which have survived in the modern II conj. class. When they belong, as in certain cases they do, to both conjugational systems, it is generally with a difference of signification,—the active formula sticking to the I conj. scheme, while the neuter characterizes the II conj. So far as the I conj. is concerned, the modern languages have followed the Latin type which, still sensible of the causal force of I conj.-forms, assigned its parasynthetic creations rather to this than to other conjugations. This was a favorite mode of verb-building in the Middle and Low Latin, and we naturally find the domain of such products very greatly extended as the analytic tendencies of the Folk's speech got a strong grasp upon the flexional system of the literary idiom. In the numerous denominatives of the mother tongue, such as *nominare*, *mollire*, etc., they had a model which already bore a factitive sense, and from which it was easy to pass, when the simple denominative failed them, to a compound form with a preposition.

With reference to the tendency of these parasyntheta to wear out, we find like phenomena in the earliest representatives of the Indo-Germanic stock. Already in the Sanskrit there was a confusion of form, if not of function, when the so-called X class causals were identical with the active primitive verbs conjugated like causals, but distinguished by no causal signification. In the Prâkrit, the digraph representation of the Sanskrit causal characteristic has been reduced to a single sign. In Persian as compared with the Zend, many of the causals, with the distinctive sign that clearly separates them from the simple verb type, have lost their force. But it is in the transition from the Indo-Ārian to the Irânian family (the Pạštô) that we find the most striking parallelism, both in mode of production and disposition to decay, with the Neo-Latin idioms. Here a periphrastic process has been adopted for the creation of its causals similar to what we have in the Romance Languages, except that the causal element, instead of being prefixed to the leading verbal notion, is hung on to it in the same way that the idea of futurity is expressed in French, Italian, etc. From this cursory glance at the early tendencies of the causal idea towards a reduction of form on the one hand, and a waning of strength on the other, we ought not to be surprised if we meet here in the Romance Languages, separated as they are by time and geographical position from the more direct sources of the language group to which they belong, even a stronger set of the current than the Indian idioms present towards a levelling of all barriers between the domains of causality and simple activity. This does not follow, however, to the extent which we might naturally expect; for, though there is a strong undertow in that direction, yet in no case does the shrinking process loosen the grip of I conjugational form on the full causal power.

On the Rights of a Greek Metropolis over its Allies. By C. D. MORRIS.

[Abstract of a paper read at the meeting of the University Philological Association, January 4, 1884].

E. Curtius, in his History of Greece (II 4, p. 219. Eng. Tr., ii, p. 498.) makes the statement that Greek colonies according to the most ancient usage were universally obliged to settle their legal disputes in the mother city. The object of this paper was to show that no such inference can be drawn from the passages which are apparently cited in defence of it, the only one of them which has a semblance of pertinence referring to a settlement which should be described as a *κληρουχία*, not as an *ἀποικία*. It was shown also that Heyne, Raoul Rochette, K. F. Hermann, Schoemann, and other writers, who have discussed the colonial relation, are unanimous in representing that according to the primitive usage, where no special reasons can be alleged to prove the contrary, the duties of a colony to its metropolis were no other than those which natural piety imposed on a daughter in relation to her mother; and that this deference in no degree implied any right on the part of the parent state to trench on the political independence of its offspring.

Note on Mercator, v. 524. By M. Warren.

[Abstract of a paper read at a meeting of the University Philological Association, February 1, 1884].

Goetz reads:

Ovém tibi eccillám dabo, natam ánnos sexagínta.

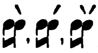
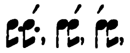
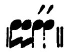
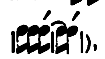
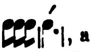
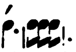
B has *tibi ancillā* and A *tibi ecillam*, although the letters *e* and *c* are doubtful, Buecheler and Ribbeck agree that *eccillam* is impossible, and the former proposes *aniculam*, the latter *auratam* as an emendation. The Romans regarded the Apulian wool as the finest, cf. Varro, L. L. ix, 89; Pliny, N. H. viii, 48, 73; Columella, vii, 2, 8; Martial, xiv, 155. Based on these passages, the reading *Apulam* was proposed and by reference to Merc. 801, where B has *anpillaspen* for *ancillas penum*, it was shown that the reverse change from *apulam* to *ancillam* paleographically considered was not improbable. A fuller statement will be found in the notes of the next number of the *American Journal of Philology*.

Musical Notation Applied to the study of Blank Verse. By A. H. Tolman.

[Abstract of a paper read at a meeting of the University Philological Association, February 1, 1884].

Mr. Alexander J. Ellis (Trans. Eng. Philological Soc., 1875–6), says that English metres should be studied by marking the Force, Length, Pitch and Weight of each syllable of a passage, and by marking each Silence or Pause. He would mark nine degrees of each quality. But Weight cannot be understood as anything apart from both Length and Force, and Pitch is "entirely variable and individual" (Schipper, Englische Metrik). Length can be marked with a good degree of accuracy by the different musical notes. All important distinctions of accent can be indicated by the presence of the following marks over the notes which represent the different accented syllables: \\, /, \\/, //, &c. Pauses which count in the verse-movement may be expressed by the different musical rests. Pauses which hold the verse-movement in suspense (cæsuras) can be expressed by the letter C, which can be made of different sizes according to duration, if desired.

Variations in the rate of movement can be expressed by underlining the notes, if the movement is retarded, and drawing lines above if it is accelerated. Mr. Ellis does not mark this at all. In all cases the actual reading of some individual should be recorded, not an ideal scansion.

According to my reading, the first five lines (25 feet) of the Passing of Arthur, Light of Asia, and Paradise Lost, contain respectively 10, 12 and 15 simple iambic feet, (), &c. The most common substitutions are: , and for two feet,  (marked by Mr. Lanier ), , and . Most of these substitutions occur in these three passages. From these fifteen lines expressed in the above notation, most of the formal principles of free blank verse are made clear to the eye. Several of them were pointed out.

PHYSICS.

The Determination of the Ohm. By A. L. Kimball.

[Reprinted from *Science*, January 4, 1884].

The importance of having a uniform standard of electrical resistance is so apparent, that the establishment of a unit which shall be suitable for practical work, and will also satisfy the demands of electrical science, has for a number of years been regarded by all electricians as of the first importance.

The requirements of such a standard are, that it shall be easily reproduced or verified; that it shall have a simple relation to the units of work, heat, etc., and therefore be based on the fundamental units of length and time; and, finally, that it shall be of so great resistance as to be suitable for all ordinary practical work.

In the year 1862 the British association decided that a unit of resistance based simply on the earth quadrant, or ten million metres, as the unit of length, and the second as the unit of time, would be of such a magnitude as to best satisfy the requirements of the case. Experiments were then undertaken by a committee of the British association with a view to the construction of standards which should accurately represent this unit of resistance, or *ohm* as it was called. Owing to some minor defects in experimentation, and to an unaccountable error in the determination of the co-efficient of self-induction of the revolving coil, their result was in error. This standard British association unit, as it is now called, is confessedly too small; but it is the basis of the so-called ohm-coils that are in current use. The latest experiments indicate that the value of the British association unit is .9867 ohms; this result having been obtained by Lord Rayleigh by two distinct methods, and by Mr. Glazebrook by still another method. But different observers still differ quite widely in their results.

The International Committee on electrical units, which met in November, 1882, in Paris, in view of the present unsettled state of the case, and the necessity for the speedy adoption of a suitable standard, decided that when the length of a column of pure mercury of one square millimetre section, and having a resistance of one ohm, shall have been determined to within one part in a thousand, the ohm shall then be defined as the resistance of such a column of pure mercury of the determined length; and the different governments represented were urged to prosecute experiments for the accurate determination of this length. For this purpose, among others, an appropriation of twelve thousand five hundred dollars was made by the last Congress of the United States. The work on the unit of resistance is under the charge of Professor Rowland of the Johns Hopkins University; and the experiments are being carried on in Baltimore, both at the university and at Clifton. Owing to some unexpected delays in the construction of necessary apparatus, the work that has been undertaken first is the determination of the specific resistance of mercury in British association units. This has been experimented upon by measuring the resistance of columns of pure mercury contained in glass tubes of various calibers and lengths, so that the resistances of the columns experimented upon range from one to ten British association units. The remaining part of the work is the determination in ohms of the resistance of the British association standard used in this determination of the specific resistance of mercury. Two principal methods will be employed for this purpose.

First, the resistance will be found by means of the mechanical equivalent of heat. The apparatus used by Professor Rowland, in his well-known work on that subject, has been set up for this purpose. It is proposed to heat some non-conducting liquid, such as alcohol or turpentine, by means of the heat developed by the passage of the current of electricity in a conductor whose extremities are kept at a known difference of potential. The same heating will then be produced, under the same circumstances, by purely mechanical means; and the resistance of the conductor will thus be determined directly from the work-equivalent of the heat developed in the conductor.

The second method to be used is that of Kirchoff, as modified by Rowland in his determination of the ohm in 1876. The instruments will, however, be in large part new, and constructed expressly for this research; so that a new set of instrumental constants will be involved. A third method, the earth-inductor method of Weber, will also be used if time permits.

For these experiments it is proposed to use, as a source of electricity in the calorimetric method, fifty Planté cells charged by a small dynamo machine. For measuring large currents of electricity an electrodynamometer has been constructed, with the Helmholtz arrangement of two large coils and a single small suspended coil. The diameter of the large coils is about one metre: that of the small suspended coil is about twenty-five centimetres. There are two sets of large coils,—one wound with large wire, about no. 8; and the other with much smaller, about no. 15. There are also two small suspended coils wound to correspond. This arrangement gives the instrument great power and range. The divided circle was made by Fauth & Co. expressly for this instrument. Four induction coils are to be wound in four parallel equidistant grooves, turned on the outside of a brass cylinder about one metre in diameter. These coils will each consist of about two hundred turns of no. 15 copper wire. This arrangement will afford great variety in the manner in which the several coils may be combined; for the inductive action of each coil upon each of the others may be taken, giving three simple combinations for each coil.

The trustees of the Johns Hopkins University have kindly placed the house at Clifton at Professor Rowland's disposal for the conduct of these experiments; and, as it stands in extensive grounds at a considerable distance from the road, it will be peculiarly suitable for delicate electrical experiments. Piers have been built for the different instruments, and a small steam-engine set up for supplying the power necessary for running the dynamo machine and the mechanical equivalent of heat apparatus. The actual experimentation will be carried on, under Professor Rowland's direction, by A. L. Kimball, assisted by H. R. Goodnow and Ensign Louis Duncan, U. S. N., the latter having been specially detailed for the work by the Navy department.

It may be added that one of the reasons which led to the construction of induction coils of such large diameter as mentioned above, is the hope of using them in a determination of the ohm by the method of Lorentz. Their large size will admit of the use of a revolving disk of more than half a meter in diameter.

It is hoped that a satisfactory conclusion will be reached by September, 1884.

MATHEMATICS.

Corrected Statement of a Theorem given in the first paragraph of p. 34 (continued from p. 33) of Circular No. 28. By J. J. Sylvester.

1°. There are the following typographical errors in the 2d paragraph, p. 34.

The second equation there given ought to read,

$$m^2n + mnm + nm^2 - 3b(mn + nm) - 3cm^2 + 3dn + 6em - 3g = 0,$$

which, when $mn = nm$ gives rise to

$$m^2n - 2bmn + dn = cm^2 - 2em + g.$$

So that making $m^3 - 3bm^2 + 3dm - f = F(m)$,

$$(F'm)n = cm^2 - 2em + g.$$

2°. When two of the latent roots of m are equal, it is easy to prove that $F'm$ is vacuous, and conversely, that when $F'm$ is vacuous, two of the latent roots of m are equal, but when $F'm$ is vacuous it is no longer permissible to drive it out of the equation, and accordingly the true statement of the theorem in question is that when m, n are two matrices of (any) the same order, such that $mn = nm$, n must *in general* be a function of m, but that this ceases to be true, when and only when m has two equal roots. The theorem requires further investigation in order to make out what happens when, or how it can happen that, two of the latent roots of one and only one of the two convertible matrices are equal; for supposing this to happen it would seem to lead to the conclusion that n may be a function of m, but m not a function of n; which, however, is not quite so paradoxical as it looks, inasmuch as in ordinary algebra a constant may be regarded as a specialized function of a variable, whilst a variable in no sense can be regarded a function of a constant. The following example of two matrices not functions of one another, but forming commutable products, has recently occurred to me in practice, and led to the discovery of the oversight I had committed in stating the theorem in question in too absolute terms.

If $x = \begin{matrix} 0 & \rho & \rho^2 \\ 1 & 0 & 1 \\ \rho^2 & \rho & 0 \end{matrix}$, $y = \begin{matrix} 0 & 1 & 1 \\ \rho & 0 & \rho^2 \\ \rho & \rho^2 & 0 \end{matrix}$ where $\rho^2 + \rho + 1 = 0$, it will be found that $xy = yx$, but that neither x nor y is a function of the other; this may easily be deduced from the fact that $x^2 - \rho^2 x - 2\rho = 0$, so that if y were any function of x, it would be reducible to the form of a linear function thereof, and consequently (on account of the zeros in the two matrices) y must be a multiple of x, which is absurd.

In like manner it will be found that $y^2 - \rho^2 y - 2\rho = 0$, and that consequently x cannot be a function of y.

3°. *Errata on pp.* 33, 34 *of Circular* 28.

P. 33, *col.* 1, l. 39, for latent *invariable* read latent *variable*;—*col.* 2, l. 13, for *restore* read *resolve*;—l. 8 from foot, after *vibrations* insert *comma*.

P. 34, *col.* 1, l. 4, after *unity* supply the words *at all events when neither m nor n possesses a pair of equal latent roots*;—l. 11, for $+3cm^2$ read $-3cm^2$;—l. 10, for $-f$ read $-g$;—l. 11, l. 13 (*passim*), for g read h;—l. 11, for $3em$ read $6em$;—l. 13, for $3bmn$ read $2bmn$;—l. 13, in numerator of fraction for $-em$ read $-2em$, and after the fraction supply the words *unless* $m^2 - 2bm + d$ *is vacuous*;—*col.* 2, l. 5, before $(MN)^{\omega-1}$ insert H; —l. 21, after *respectively* insert (*to a numerical factor près*).

Elementary Proof of Stirling's Theorem. By F. Franklin.

$$\begin{aligned}
n! &= n(n-1)(n-2)(n-3)\dots 3.2.1,\\
&= n^n\left(1-\frac{1}{n}\right)\left(1-\frac{2}{n}\right)\dots\left(1-\frac{n-2}{n}\right)\left(1-\frac{n-1}{n}\right),\\
&= n^n\left(1-\frac{1}{n}\right)^{n-1}\left(1-\frac{1}{n-1}\right)\dots\left(1-\frac{n-3}{n-1}\right)\left(1-\frac{n-2}{n-1}\right),\\
&\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\\
&= n^n\left(1-\frac{1}{n}\right)^{n-1}\left(1-\frac{1}{n-1}\right)^{n-2}\dots\left(1-\frac{1}{3}\right)^2\left(1-\frac{1}{2}\right), && (1)\\
&= \frac{n^n\left(1-\frac{1}{n}\right)^{n}\left(1-\frac{1}{n-1}\right)^{n-1}\dots\left(1-\frac{1}{3}\right)^3\left(1-\frac{1}{2}\right)^2}{\left(1-\frac{1}{n}\right)\left(1-\frac{1}{n-1}\right)\dots\left(1-\frac{1}{3}\right)\left(1-\frac{1}{2}\right)},\\
&= n^{n+1}\left(1-\frac{1}{n}\right)^{n}\left(1-\frac{1}{n-1}\right)^{n-1}\dots\left(1-\frac{1}{3}\right)^3\left(1-\frac{1}{2}\right)^2. && (2)
\end{aligned}$$

The limit, for $x = \infty$, of $\left(1-\frac{1}{x}\right)^x$ or of $\left(1-\frac{1}{x}\right)^{x-1}$ is $\frac{1}{e}$, and it is easily seen, by the binomial theorem, that for all positive values of x the first of these expressions is smaller and the second larger than this limit; hence we have at once, from (1) and (2), that $n!$ is, for all values of n, included between $n^n e^{n-1}$ and $n^{n+1}e^{n-1}$.

To get a more accurate expression, we have only to employ the expansions of $\log\left(1-\frac{1}{x}\right)^x$ and $\log\left(1-\frac{1}{x}\right)^{x-1}$; taking the arithmetical mean of the values given by (1) and (2) for the logarithm of $n!$, we find

$$\log(n!) = \log\frac{n^{n+\frac{1}{2}}}{e^{n-1}} - \tfrac{1}{2}\sum_{x=2}^{x=n}\left(\frac{1}{2.3}\cdot\frac{1}{x^2} + \frac{2}{3.4}\cdot\frac{1}{x^3} + \frac{3}{4.5}\cdot\frac{1}{x^4} + \dots\right). \qquad (3)$$

Since the sum contained in this expression tends to a finite limit as n tends to infinity, we may write, for n very large,

$$n! = C\frac{n^{n+\frac{1}{2}}}{e^{n-1}},$$

and then determining C in the usual way by the aid of Wallis's theorem, we have Stirling's formula. Of course the value of C is already determined, though not in a convenient form, by equation (3).

A Reduction of $2u = (u_{11}, u_{12}, \dots)(x_1, x_2, \dots)^2$ to a Sum of Squares. By A. S. Hathaway.

[Abstract of a communication to the University Mathematical Association, January 16, 1884].

Integrating $\frac{d^2u}{dx_1^2}\frac{du}{dx_1}$ in the forms $u_{11}\frac{du}{dx_1}$ and $u_1\frac{du_1}{dx_1}$ leads to an equation,

$$2u_{11}u = u_1^2 + 2'u, \qquad (1)$$

where the constant of integration $(2'u)$ is a quadratic function of x_2, $x_3, \dots$ whose coefficients are determined by differentiating (1). Thus

$u_{st} = (u_{11}u_{st})$, and the discriminant of ${}'u$ is formed by eliminating all the constituents in the first column of the discriminant of u, except u_{11} (as we eliminate coefficients from a set of equations) and taking the compound determinant so formed. The same process may be repeated on ${}'u$ and so on. The coefficients of ${}^{m}u$ are defined by

$${}^{m}u_{st} = \prod_{r=1}^{r=m} ({}^{r-1}u_{rr})^{m-r} \cdot (u_{11}u_{22} \dots u_{mm}u_{st}).$$

This enables us to obtain from the general equation

$$2^{m-1}u_{mm}{}^{m-1}u = {}^{m-1}u_{m}^{2} + 2^{m}u,$$

by elimination of common factors, an equation which summed with respect to m gives

$$2u = \sum_{m} \frac{\left\{\sum_{t}(u_{11} \dots u_{m-1.m-1}u_{mt})x_t\right\}^2}{(u_{11} \dots u_{m-1.m-1})(u_{11} \dots u_{mm})}. \qquad (2)$$

The necessary and sufficient conditions in order that all the terms in this sum may have the same sign are that the determinants of even order $(u_{11}u_{22})$, $(u_{11} \dots u_{44}) \dots$ be all positive and those of odd order, u_{11}, $(u_{11} \dots u_{33})$ have like signs. We may also obtain the conditions that $2u$ be incapable of reduction to a sum of squares; or that it reduces to a less number of squares than it contains independent variables. Several theorems with regard to symmetrical determinants are also involved in (2).

The Degeneration of Unicursal Curves. By G. Bissing.

[Abstract of a paper read at a meeting of the Mathematical Society, December 19, 1883].

Taking x_1, x_2, x_3 as trilinear coordinates and θ and u as the arbitrary parameters, the conditions for the degeneration of the unicursal curve

I. $\qquad \theta x_i = a_i u^n + b_i u^{n-1} + c_i u^{n-2} + \dots l_i, \qquad (i = 1, 2, 3),$

into a right line and a locus of the n — 1st degree were shown to be

$$(a_1b_2c_3) = 0, \qquad (a_1b_2d_3) = 0 \dots (a_1b_2l_3) = 0.$$

By then dialytically eliminating u and θ from the three equations I, we see that under these conditions the resulting determinant is equal to a mere constant times $[(a_2b_3)x_1 + (a_3b_1)x_2 + (a_1b_2)x_3]^n$; that is to say, a unicursal curve of degree n can only consist in part of a right line if it be that line counted n times over. It was also remarked that the discriminant of $\theta x_i = a_iu^2 + b_iu + c_i$, $(i = 1, 2, 3)$ was equal to $-4(a_1b_2c_3)^4$. These results are of interest in the theory of Steiner's quartic.

Second Note on Weierstrass' Methods in the Theory of Elliptic Functions. By A. L. Daniels.

[Abstract of a paper in the *American Journal of Mathematics, Vol. VI, No. 3*].

This second note is mainly an expansion and more minute exposition of the theorems in the first hasty sketch. The starting point of the whole theory is a functional problem which is in essence an addition theorem. The necessary limitations are there shown which exclude all except periodic functions in general. The next step is the complete determination of a function by means of its zero points and the condition that its only essential singularity shall be at infinity. In order that the function be periodic, the number of zero points must be infinite. If they form a singly infinite series, the prime factors of the infinite product have the form $\left(1 - \frac{u}{a_v}\right)e^{\frac{u}{a_v}}$, and we are led to the sine; if they form a doubly infinite series, the prime factors are of the form $\left(1 - \frac{u}{a_v}\right)e^{\frac{u}{a_v} + \frac{1}{2}\frac{u^2}{a_v^2}}$, and we have the sigma function. All possible doubly periodic functions are then expressible very simply as sigma-quotients of the form $\frac{\sigma(u - a_1)\sigma(u - a_2) \dots \sigma(u - a_r)}{\sigma(u - b_1)\sigma(u - b_2) \dots \sigma(u - b_s)}$; the ordinary elliptic functions corresponding to the special case, $r = s = 2$, $a_1 + a_2 = b_1 + b_2$. The sigma function is quasi periodic, and corresponds to the ϑ and Θ of Jacobi. The second logarithmic derivative negatively taken is however a true doubly periodic function. A discussion of the four sigma-functions and their quotients will follow.

HISTORY AND POLITICAL SCIENCE.

A New Labor Problem in California. By C. H. Shin

[Abstract of a paper read before the Seminary of Historical and Political Science, N
ember 16, 1883].

This paper was a study of certain features of the social and industri
growth of the Pacific Coast, particularly of California, and was suggest
in part by reports of several meetings which the fruit-growers of th
State held last October and November. A strange state of affairs w
shown to exist there, and a new labor-problem, entirely disconnect
with the "Chinese Question," is thought to be close at hand. Califorr
has had a checquered economic career. In 1840 the country was a v
pasture, the Mission Padres owning sheep, cattle, and horses by t
hundred thousand. By 1850 mining was the chief industry. Next ca
the era of wheat-farms over valleys formerly purely pastoral. But wh
grew less profitable, and what is now the peculiar industry of Califor
attracted attention; there was a rapid horticultural development witho
parallel in any other country or in any other historic period. The s
had peculiar fertility, and the climate peculiar gifts. The sudden des
took possession of Californians to furnish dried and canned fruits, nu
olive-oil, wines, raisins, etc., for the world's markets. An agrari
excitement arose. Land five hundred miles from San Francisco, in roug
rocky, brush-covered mountains rose to $60 and $100 per acre; students a
laborers and clerks formed land associations; colony enterprises were ve
numerous, and some were grand successes, others were sad failures.
one case in the southern part of the State, land bought fifteen years a
at less than a dollar per acre is paying ten per cent. interest on more th
$4,000 per acre to the fortunate colonists.

The excitement had a basis in fact, for the orchards already in beari
paid large sums. Vineyards, once unprofitable, made many persons ind
pendent. Twelve acres of apricots paid one man $35,000 in three yea
the crop on one acre of cherry trees sold for $1.200. Such yields caus
thousands upon thousands of vines and trees to be planted; in eve
county in the State small homesteads increased, and there was a hope th
the large cattle and wheat ranches would soon be things of the past. T
fascinations of the intensive system of horticulture, of tiny fruit-farm
beautiful homes, and luxuriant semi-tropic gardens were everywhere fe
Yet there was an unexpected danger ahead. Climate, rapid growth, tre
bearing in a few years, great fruitfulness, the enthusiasm that had rush
into horticulture so rapidly—these proved our bane. There was not enou
labor. Fruit crops require a large force of men in summer, but few
winter; they need tenfold the force that ordinary farming does. In 18
wages were higher than in 1881, and in 1883 have been still higher, thou
day's wages have always been greater in California than in any oth
State. Now, the fruit-growers say that there is no possible chance
having laborers enough to handle the crop of 1883, or 1890, even if
more vines or trees are planted. They say that twenty-fold the prese
labor force will be needed. California probably has about 120,000,0
grape vines, and 15,000,000 fruit trees now planted, and planting
going on with unceasing vigor. The products, too, that will aid in ma
ing this expected labor-famine are very numerous, flowers for perfume
seeds, spices, gums, medicinal substances, and many crops that depe
for profit on abundant hand-labor, industries capable of great extensi
if all the conditions are favorable. Machinery only accentuates the d
parity between the winter-need and the summer-need; it cannot gath
fruit, nor pack it for shipment. A wheat farm of 600 acres employs thr
or four men, and annually produces from $9,450 to $18,900 in wheat;
fruit-colony of 600 acres needs 60,000 trees to plant it, spends $180,0
perhaps, before it is profitable, and then the annual sales of fruit produ
may equal or exceed $600,000. The fruit-colony will need a village
laborers, unless the separate tracts are very small indeed. Letters to t
State Horticultural Society have rated gross sales of fruit per acre at fr
$400 to $2,000. It seems as if much higher wages might be paid, but
much labor is required that if wages were doubled the profit would
annihilated.

The Horticultural Utopia that California dreamed of was one wher
body of laborers twentyfold the land-owning population should spring fr
the soil, work in the summer months, and disappear from view the rest of t

year. There are few manufactories; the towns, outside of three or four like Oakland, San Jose, and Sacramento, are mere villages; the question of what to do with laborers during the winter months is a very perplexing problem in practical economics. A strong effort will be made to train boys from San Francisco (the "Hoodlums") into habits of industry, and make them useful grape-pickers. The leading growers will build cottages and establish families in a sort of feudal fashion on small lots near them, and there will be an effort to bring laborers from Europe—Italians, Germans, and Norwegians.

The paper then discussed the effect upon the State of this probable over-production, and lack of labor, which had checked the monopoly of fruit-lands and the formation of immense fruit-farms, and which would help the development of small orchards and colony enterprises, leading in the process of time to a varied and mutually-supporting system, no longer one-sided, as in the past. The hope for California is, that out of all this, a form of society based upon intensive horticulture, irrigation, colonies, ownership of small tracts, and much out-door life, will be developed.

Indian Money as a Factor in New England Civilization. (*A Chapter in the Economic History of New England*). By W. B. WEEDEN, of Providence, R. I.

[Abstract of a paper read before the Seminary of Historical and Political Science, November 9, 1883].

There was an intimate intercourse between white and red men in colonial life during half a century, which largely increased the resources of the new communities. After the commercial, industrial, or purely economic element in this life had worked itself out, there was little wholesome or prosperous intercourse between the two races. The efforts of the colonists to turn the natives to another civil and religious system, to tear them out of aboriginal life and plunge them into the Hebrew-European living of the new comers—to civilize them into copper-colored Puritans—failed, and, from the nature of the case, must have failed.

Wampum consisted of beads or cylinders made from the solid parts of sea shells—white wampum from the periwinkle, black from the quahog—with much labor and artistic skill. Wampum had a constant commercial value in barter among the natives, and after the colonists took it up, it became a true currency in all transactions. As Morton said in his New England Canaan, 1632, "Sell for this Wampampeak, because we know we can have beaver again of them for it." This desire of the natives made it virtually redeemable in beaver, as long as they had furs in abundance. It played back and forth in aboriginal and colonial trade, becoming quite as useful as silver. Specie was needed in Europe and drifted away, while the shell money remained a sure basis of trade, as long as the native could produce after his fashion, and keep up the demand for his peculiar money.

In 1641 it was a full legal tender under £10 in all New England. Massachusetts refused it for taxes in 1649, but kept it otherwise current until 1661. It was in common use, not in "country pay" like grain and produce, but as money in small sums until the close of the century. It was found thus used in 1704.

It is not easy to comprehend at first thought the Indian idea of these beads. Their economic value appears in these transactions, but underlying this, there was a mystic or symbolic value. Embroidered on belts and garments for personal adornments, beads also entered into every aboriginal ceremony, being cherished as are jewels in civilized life. Association converted these pictured symbols into history, a mnemonic record. Facts were talked into the belts, then they were laid away in council houses, to be taken out and read by interpreters to future generations. The Iroquois had no other records for their incipient empire.

The life of the two races could not commingle, despite the effort of good Christians like Eliot and Williams. Colonial life was based upon civil law as well as upon Christianity. The *totem* system of clan organization was a rude civic system, which sundered the native from the European, even more widely than their religions separated them. The essay further showed the conflict of these systems, which finally destroyed the weaker race, and with it the trade and intercourse which wampum built up.

The Guild Merchant. An Introduction to English Municipal History. By DR. CHARLES GROSS.

[Abstract of a paper read before the Seminary of Historical and Political Science, November 23, 1883. The paper was a brief English summary of a German thesis on the "*Gilda mercatoria*, Ein Beitrag zur Geschichte der Englischen Städteverfassung." The original thesis was suggested by the late Professor Pauli. It was accepted as a doctor's dissertation in Goettingen, and was there printed in 1883, 109 pp. oct

The study of the English municipality by itself is well adapted to prepare us for the study of American institutional history, not only because it is the natural introduction to the history of the American city, but also because, when approached in the proper spirit, it comprehends the study of the local institutions of England in general. The materials for the investigation of the English municipality have not yet been properly investigated. It is a promising field of original research even for Americans. The following is one of a series of investigations on this subject made by Dr. Gross preparatory to the study of early American institutional history.

The *Gilda Mercatoria*, or Guild Merchant, probably originated shortly after the Norman Conquest, which gave an impulse to the domestic and foreign commerce of England. Out of 160 boroughs existing between 1295 and 1307 at least from 80 to 90 were provided with this brotherhood. It was a very characteristic and not a mere fortuitous feature of English municipal government in the middle ages. In no other country was it so powerful or so prevalent. At the head of the guild stood an alderman and his four colleagues. The latter in some places were called scabini or custodes (skevins or wardens). Sometimes we find merely two senescalli (stewards) at the head of the organization. These officers had charge of the property and monies of the society. The alderman of the guild must be distinguished from the highest executive officer of the borough (the mayor or provost or bailiff). The Guild Merchant was a very important but only a specific and subsidiary part of the administrative machinery. Most of the burghers were members of the Guild Merchant, but not all of them. Non-burghers were also in the guild. Thus the prevailing opinion that "men of the guild" and "men of the borough" are synonymous terms, is untenable. No one has even attempted to answer the fundamental question just what were the functions of the Guild Merchant, what was its *raison d'être*. Briefly stated it was that department of municipal government which regulated commerce. It had the power to monopolize the trade of the town. Only its members could buy and sell on the most favorable terms. It laid such restrictions upon traders who were not of the guild, as it thought most consonant with the prosperity of the town. The two privileges of the brotherhood most frequently emphasized were the right to sell at retail and freedom from tolls and duties (at least excessive tolls and duties) in buying. Thus the functions of the guild and consequently of the alderman and his four skevins were economic; but the chief functions of the mayor or provost or bailiff of the town with his council of twelve or twenty-four were judicial. On entering the guild the new member promised to be "in scot and lot" with the burghers. This duty of being in scot and lot is as inseparably connected with the conception Gilda Mercatoria as the corresponding privilege of participating in the trade of the town on the most favorable footing. "Scot and lot" here signify what was originally implied in the term "scot" alone. In other words the principal thing required of the guild-brother was a money contribution whenever the town coffers needed replenishing. The most important part of our subject is, perhaps, a consideration of the influence of the Guild Merchant upon the origin of the English municipality and of the later legal conception of the English municipal corporation. This would lead into details beyond the limits of this abstract. The influence of the guild in the directions above indicated has been exaggerated. What has been said of the Gilda Mercatoria refers mainly to the twelfth and thirteenth centuries. In the fourteenth and fifteenth centuries a great change took place. In some towns the guild had completely disappeared. In others it was transformed into a mere social and religious brotherhood, having no public functions whatsoever. In others the later Merchant adventurers became its lineal descendant. In many towns it continued to vegetate, but it was no longer the old Guild Merchant. The alderman had vanished. The guild had no longer its own clearly defined functions. It had been, as it were, absorbed or lost in the general organization of the town. Borough and guild as well as burghers and guild-brethren were now synonymous terms. In the eighteenth century the Guild Merchant was merely the shadowy phantom of an institution long dead,—a hazy indefinite term, the significance of which was unknown even to the few municipal magistrates in whose mouths it was still current. Even to this day it exists in a single town of England. The Guild Merchant of Preston is a feast which for more than three centuries has been celebrated once every twenty years. The last Guild Merchant was observed in September, 1882. The centuries have wrought a marvellous change in an institution that once held a most important place in the local annals of England.

The Virginia Parish. By Edward Ingle.

[Abstract of a paper read before the Seminary of Historical and Political Science, January 11, 1884].

The parish in Virginia was a growth acquiring, or casting aside powers as necessity arose. Parishes were originally laid off within plantations; later, parish and county limits were coincident. With an increase of population, the parish was divided into smaller ones, which afterwards became the basis for counties. At first, the officers in a parish were the minister and four best men, who developed gradually into the rector, churchwardens, and vestrymen. A vestry of twelve were elected for an indefinite period, and could be dissolved only by Act of Assembly. They met at least twice in each year—at Easter to elect wardens, in the fall to lay the levy. They were the trustees of any free school and directed the affairs of the parish workhouse. Their executive officers were the two churchwardens, elected annually from among themselves. The wardens looked after the parish poor and saw that they were comfortably housed in private dwellings or in the workhouse. They preserved order in church, and had to seat everyone according to his station. They could commit vagrants to the workhouse, and had to keep a list of poor people in the parish. With the minister, they presented immoral persons to court, and could sell a woman convicted of bastardy for a term of five years. They kept the church in order and provided the elements for communion. The minister was either employed by the year, inducted by the governor, or by the parish. This matter was in dispute for over a century, and was settled only by the Revolution, which resulted in destroying the parish, save as an ecclesiastical organization.

Recent Discussion on the Study of Roman Law in Universities. By W. B. Scaife.

[Abstract of a paper read before the Seminary of Historical and Political Science, January 4, 1884].

Of original historical sources the law is in many respects the most important and the most trustworthy; law is "a sort of skeleton," says Mr. Froude, "upon which flesh and blood and color can be laid on from other authorities, with a certainty that the true proportions are still observed." As to the value of law for this purpose we can add the authority of Gibbon and Froude, besides that of other men of less note. Gibbon said: "The laws of a nation form the most instructive portion of its history." In an essay entitled "Suggestions on the best means of teaching English history," Froude asserts again and again that the only true way of teaching history is by the use of the statute book as the basis. He says, "the study of history in the Statutes will form the most wholesome corrective to that particular form of error now so prevalent * * * that of looking for the causes of great popular movements, of great events, which determine the fates of kingdoms, in the small whims and caprices of individual princes and ministers." Priestley said as long ago as the last century, that "the laws of a country are necessarily connected with everything belonging to the people of it; so that a thorough knowledge of *them*, and of their progress, would inform us of everything that was most useful to be known about them," [the people]. Mr. Bryce believes that "the study of law enables the historian to correct theoretical views of politics and civil society." In the law, he finds "a record of the action of the forces of society, the prevailing ideas of the times, means for gaining an insight into the intellectual condition of the country, in a limited extent the evidence of the moral attitude of people, and the expression of the economic will and needs of the l giving authority and through it of those of the people."

The laws of each country are generally of historical use only for t country. But Roman law is of wider significance, of more exten influence; for to it every civilized nation of the earth owes more or of its laws and institutions. Wherever, then, history is taught to any c siderable extent Roman law should be taught in connection with it. sense of this need is growing in American universities. The universi of continental Europe have long taught it. But they had a very obvi reason, in that the legal systems of their countries were evidently foun on the Roman; while the fact that a knowledge of Roman law thr light on many questions of ancient and modern history was probably generally recognized until after the appearance of Savigny's great w early in the present century. For a long time Englishmen and Am cans generally were under the impression that Roman law had had li or no effect on English law, and hence, that the study of it would b them of little practical value. But better historical knowledge has pro the contrary; and it is now universally acknowledged that English l owes much to civil law.

Correction.—The librarian of the State Department, Washingt D. C., requests a statement in these columns that the English translati of the treaty between the Athenians and Chalcidians, referred to in last *Circular*, was not the work of the department's translator but communicated from abroad.

H. B. A

The first issue in the Second Series of the Johns Hopkins Universi Studies in Historical and Political Science will be a double nu ber, comprising about one hundred pages, upon "Methods of Histori Study," by the editor of the series. The methods considered are t topical, the comparative, the co-operative, and the seminary metho Under the last head is a full discussion of seminary methods in Germa France, Belgium, and the United States.

BIOLOGY.

On a Cilio-flagellate Infusorian recently observe in Baltimore Drinking Water. By C. S. Dolley.

[Abstract of some remarks before the University Scientific Association, Febru 6, 1884].

Having had my attention called to the presence of large numbers of peculiar minute, green organism in the water supply of the Biologi Laboratory, I became interested in identifying the same and find it to a species of *Peridinium*. So far as I have been able to ascertain the on member of the family *Peridiniidae* hitherto described as occuring America is a salt water species from the coast of South Carolina. Aft examining the specimens found here, very carefully, and comparing the with the specific descriptions given by Kent, I find that while they agr in most respects with *Peridinium tabulatum*, they also have many poin in common with *Peridinium apiculatum*, though differing in sever particulars from both. They would therefore seem to constitute intermediate species, or variety, if in accordance with Stein, *P. apiculatu* be regarded as only a variety or older phase of *P. tabulatum.* T characters of our Baltimore specimen are as follows: Body ovate sub-globose as seen in dorsal or ventral aspect, with a convex dorsal a concave ventral surface as seen in lateral aspect: cuirass composed numerous polygonal facets which in the row next to the equatori furrow are separated by a clear space, the edges of these spaces as well of the longitudinal and equatorial furrows are finely hispid. The remai ing facets are closely united, all the facets have a very marked reticula structure with the exception of the narrow linear ones in the equatori furrow. There is a deep notch or sulcus in the extremity of the posteri segment continuous with the longitudinal furrow of the ventral surfac The equatorial groove does not remain in the same plane in passing aroun the body, but upon the ventral surface where it is joined by the longitud nal furrow it exhibits a fault, being in fact one turn of a spiral. T margins of the equatorial groove are everted and present laterally t appearance of tooth-like processes. The flagellum is very delicate and inserted at or near the posterior sulcus in the longitudinal furrow. I was only able to detect it in specimens killed with osmic acid. I could detect cilia only at the posterior sulcus, on each side of which they present a tuft-like appearance.

The eye-like pigment spots are rather infrequently present, and vary from one to three or four in an individual, being located at one side of the longitudinal fissure. The color of the Infusorian is a yellowish green, and its diameter 1.-520″. It moves with a rolling motion about its dorso-ventral axis, and was mistaken at first for a Volvox or Zoospore. It is attracted by light, moves about freely on the slide, but ceases its motion if the slide be jarred or struck. Many of the specimens which had been kept in a large dish seemed to have taken on a resting stage; the endoplasm being retracted from the walls of the cuirass, and containing numerous oil globules. I was not able to find any of the "lunate encystments" mentioned by Kent, nor could I make out the existence of an endoplast.

The observations of Mr. Carter of Bombay indicate that the gregarious habit of *Peridinium* may at times render it a potent factor in the contamination of drinking water and the peculiar taste of Baltimore water at times may be due in part to large numbers of Peridinia dying and decaying in the pipes.

MINERALOGY.

Barite Crystals from De Kalb, N. Y. By G. H. WILLIAMS.

The University Mineral Collection has recently received from Mr. C. D. Nims of Jefferson Co., N. Y., a fine suite of barite crystals found on the land of Mr. McIntyre, in the township of De Kalb, St. Lawrence Co., N. Y. Dana mentions barite from De Kalb, but this particular locality is altogether new and therefore deserves a brief notice. Mr. Nims could give no very definite information about the mode of occurrence as he had not himself visited the locality. The crystals occur in large aggregates radially arranged about a spherical core which is from 4 to 6 inches in diameter. The crystals recently received, 23 in number, were all loose, having been broken away from the central mass. They were generally single, although, in some instances, three or four are grown together with their axes approximately parallel. The largest are 8 cm. long and about 3 cm. broad. They are elongated in the direction of the brachydiagonal, exhibiting only the simple combination, $0P.P\breve{\infty}$ and $\frac{1}{2}P\bar{\infty}$. In one instance ∞P was observed. The cleavage is very distinct, parallel to $0P$ and ∞P. When fresh the crystals are colorless and quite transparent, but as a rule they are more or less altered. This alteration appears first as a roughening of the $P\breve{\infty}$ and $\frac{1}{2}P\bar{\infty}$ planes by minute, regularly arranged indentations, resembling in their position, but not in their form, the artificial etched figures. As the alteration proceeds the substance of the crystal is changed, always parallel to the planes mentioned, into a white, opaque material, which a qualitative chemical analysis showed to be only sulphate of barium. The basal plane always remains intact and the effect is as though the domes had been coated to a greater or less thickness by a secondary substance. The edge $\frac{1}{2}P\bar{\infty} \wedge \frac{1}{2}P\bar{\infty}$ seems especially subject to this alteration, and is hence often apparently replaced by $\infty P\breve{\infty}$. ∞P is also apparently produced in the same manner. A similar process of weathering is mentioned by Roth (Allgemeine ch. Geologie, I, p. 91,) in the case of celestite, and was observed on one crystal of that mineral in the collection from Put in Bay. Interesting is the deposition, subsequent to the alteration, of minute plates of barite arranged exactly parallel to the large crystal upon the faces $0P$ and $\frac{1}{2}P\bar{\infty}$.

REPORTS OF RECENT LECTURES AND ADDRESSES.

IV. Dr. Hartwell's Address on Physical Culture.

On the occasion of the opening of the New Gymnasium, December 7, 1883, an address was made by Dr. E. M. HARTWELL, in Hopkins Hall, to the students of the University and others.

The speaker contrasted the theories concerning the nature of body and mind and their relations each to each as held by the ancient Greeks, with those propounded by the early Fathers of the Church, and also with the theories and ideals which the monks on the one hand and the knights on the other, strove to realize during the Middle Ages; and briefly reviewed the different systems of training based upon them.

Special attention was called to the clear distinction made by the Greeks, between gymnastics and athletics, and to the low esteem in which professional athletes were held by Greek physicians, philosophers, and soldiers.

He then spoke of modern ideas concerning bodily training and the means adopted to further it.

"In modern schemes of education," he said, "the part allotted to bodily training and recreation has been determined chiefly by the dominion exercised singly or in combination over the minds of Faculties and Boards of Trust by the Greek, the monkish, or the knightly ideal of manly excellence. The Germans under the lead of Gutsmuths and of Jahn, the father of the famous Türnvereins, have been enamored of the example of the Greeks, and have striven in an elaborately systematic way to embody Greek gymnastics in modern forms. France, apparently out of respect for Prussia, has recently given physical training a prominent place in its revised educational code." . . .

"In England where there is an aversion to systematic efforts to train the bodies of scholastic youth, gymnasiums exist chiefly as private ventures or in connection with the recruiting service for the army; they are not maintained or regulated by the great educational foundations. Certain national sports are considered by the educated class as being an undoubted and important factor in British supremacy; and in spite of the marked survival of mediaeval monkish ideals and forms in the organization and administration of Oxford, Cambridge, and the Public Schools, chivalric notions as to bodily force and grace are most clearly traceable in the sober passion of the British school boy and undergraduate for athletic games and manly sports; which, it should be remembered, are regulated almost entirely by the force of custom among the pupils themselves. The English and the German modes of bodily training are natural outgrowths from congenial soil, to such a degree that both Germans and Englishmen seem incapable of appreciating the merits of each other's ideas and methods." . . .

"In the United States prior to 1825, there was little interest in anything akin to gymnastics for students. American educators were ruled largely by English notions as to curriculum and discipline, and American collegians, who were not too serious to play, disported themselves after inherited English fashions. In one of our prominent colleges, the faculty used to grant the students a full holiday, on the condition that they would devote it to re-gravelling the college walks 'for the purpose,' as we learn, 'of forming in the students the habit of physical exercise, so essential to vigorous mental exertion.' The first gymnasiums in this country were constructed out of doors in bald imitation of the Graeco-German model, and a transient interest in gymnastics was evoked by exiles from Germany. Professors Beck, Follen, and Lieber were foremost in introducing the ideas and exercises of the German Turners. The Round-Hill School at Northampton, Massachusetts, in 1825, seems to have been the first institution in this country to make gymnastic exercise a part of the regular course of instruction. Harvard and Yale were provided with out-of-door gymnasiums in 1826. From these beginnings have been evolved the American college gymnasium as it exists to-day at Amherst and Harvard, at which institutions costly buildings, elaborately fitted with gymnastic appliances, are in charge of competent medical men in good and regular standing as members of the college faculty."

The speaker reviewed the experience of the Department of Physical Culture at Amherst, where gymnastic exercise has been required of the students since 1860. The athletic revival of late years was alluded to, and the increasing attention paid by college authorities to the physito its metropolis were no other than those which natural piety imposed on a daughter in relation to her mother; and that this deference in no degree implied any right on the part of the parent state to trench on the political independence of its offspring.

Note on Mercator, v. 524. By M. Warren.

[Abstract of a paper read at a meeting of the University Philological Association, February 1, 1884].

Goetz reads:

Orém tibi eccillám dabo, natam ánnos sexaginta.

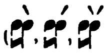
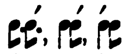
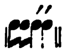
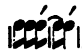
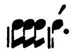
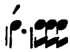
B has *tibi ancillá* and A *tibi ecillam*, although the letters *e* and *c* are doubtful, Buecheler and Ribbeck agree that *eccillam* is impossible, and the former proposes *aniculam*, the latter *auratam* as an emendation. The Romans regarded the Apulian wool as the finest, cf. Varro, L. L. ix, 89; Pliny, N. H. viii, 48, 73; Columella, vii, 2, 8; Martial, xiv, 155. Based on these passages, the reading *Apulam* was proposed and by reference to Merc. 801, where B has *anpillaspen* for *ancillas penum*, it was shown that the reverse change from *apulam* to *ancillam* paleographically considered was not improbable. A fuller statement will be found in the notes of the next number of the *American Journal of Philology*.

Musical Notation Applied to the study of Blank Verse. By A. H. Tolman.

[Abstract of a paper read at a meeting of the University Philological Association, February 1, 1884].

Mr. Alexander J. Ellis (Trans. Eng. Philological Soc., 1875–6), says that English metres should be studied by marking the Force, Length, Pitch and Weight of each syllable of a passage, and by marking each Silence or Pause. He would mark nine degrees of each quality. But Weight cannot be understood as anything apart from both Length and Force, and Pitch is "entirely variable and individual" (Schipper, Englische Metrik). Length can be marked with a good degree of accuracy by the different musical notes. All important distinctions of accent can be indicated by the presence of the following marks over the notes which represent the different accented syllables: \, /, \/, //, &c. Pauses which count in the verse-movement may be expressed by the different musical rests. Pauses which hold the verse-movement in suspense (cæsuras) can be expressed by the letter O, which can be made of different sizes according to duration, if desired.

Variations in the rate of movement can be expressed by underlining the notes, if the movement is retarded, and drawing lines above if it is accelerated. Mr. Ellis does not mark this at all. In all cases the actual reading of some individual should be recorded, not an ideal scansion.

According to my reading, the first five lines (25 feet) of the Passing of Arthur, Light of Asia, and Paradise Lost, contain respectively 10, 12 and 16 simple iambic feet, (), &c. The most common substitutions are: , and for two feet,  (marked by Mr. Lanier ), , and . Most of these substitutions occur in these three passages. From these fifteen lines expressed in the above notation, most of the formal principles of free blank verse are made clear to the eye. Several of them were pointed out.

PHYSICS.

The Determination of the Ohm. By A. L. Kimball.

[Reprinted from *Science*, January 4, 1884].

The importance of having a uniform standard of electrical resistance is so apparent, that the establishment of a unit which shall be suitable for practical work, and will also satisfy the demands of electrical science, has for a number of years been regarded by all electricians as of the first importance.

The requirements of such a standard are, that it shall be easily reproduced or verified; that it shall have a simple relation to the units of work, heat, etc., and therefore be based on the fundamental units of length and time; and, finally, that it shall be of so great resistance as to be suitable for all ordinary practical work.

In the year 1862 the British association decided that a unit of resistance based simply on the earth quadrant, or ten million metres, as the unit of length, and the second as the unit of time, would be of such a magnitude as to best satisfy the requirements of the case. Experiments were then undertaken by a committee of the British association with a view to the construction of standards which should accurately represent this unit of resistance, or *ohm* as it was called. Owing to some minor defects in experimentation, and to an unaccountable error in the determination of the co-efficient of self-induction of the revolving coil, their result was in error. This standard British association unit, as it is now called, is confessedly too small; but it is the basis of the so-called ohm-coils that are in current use. The latest experiments indicate that the value of the British association unit is .9867 ohms; this result having been obtained by Lord Rayleigh by two distinct methods, and by Mr. Glazebrook by still another method. But different observers still differ quite widely in their results.

The International Committee on electrical units, which met in November, 1882, in Paris, in view of the present unsettled state of the case, and the necessity for the speedy adoption of a suitable standard, decided that when the length of a column of pure mercury of one square millimetre section, and having a resistance of one ohm, shall have been determined to within one part in a thousand, the ohm shall then be defined as the resistance of such a column of pure mercury of the determined length; and the different governments represented were urged to prosecute experiments for the accurate determination of this length. For this purpose, among others, an appropriation of twelve thousand five hundred dollars was made by the last Congress of the United States. The work on the unit of resistance is under the charge of Professor Rowland of the Johns Hopkins University; and the experiments are being carried on in Baltimore, both at the university and at Clifton. Owing to some unexpected delays in the construction of necessary apparatus, the work that has been undertaken first is the determination of the specific resistance of mercury in British association units. This has been experimented upon by measuring the resistance of columns of pure mercury contained in glass tubes of various calibers and lengths, so that the resistances of the columns experimented upon range from one to ten British association units. The remaining part of the work is the determination in ohms of the resistance of the British association standard used in this determination of the specific resistance of mercury. Two principal methods will be employed for this purpose.

First, the resistance will be found by means of the mechanical equivalent of heat. The apparatus used by Professor Rowland, in his well-known work on that subject, has been set up for this purpose. It is proposed to heat some non-conducting liquid, such as alcohol or turpentine, by means of the heat developed by the passage of the current of electricity in a conductor whose extremities are kept at a known difference of potential. The same heating will then be produced, under the same circumstances, by purely mechanical means; and the resistance of the conductor will thus be determined directly from the work-equivalent of the heat developed in the conductor.

The second method to be used is that of Kirchoff, as modified by Rowland in his determination of the ohm in 1876. The instruments will, however, be in large part new, and constructed expressly for this research; so that a new set of instrumental constants will be involved. A third method, the earth-inductor method of Weber, will also be used if time permits.

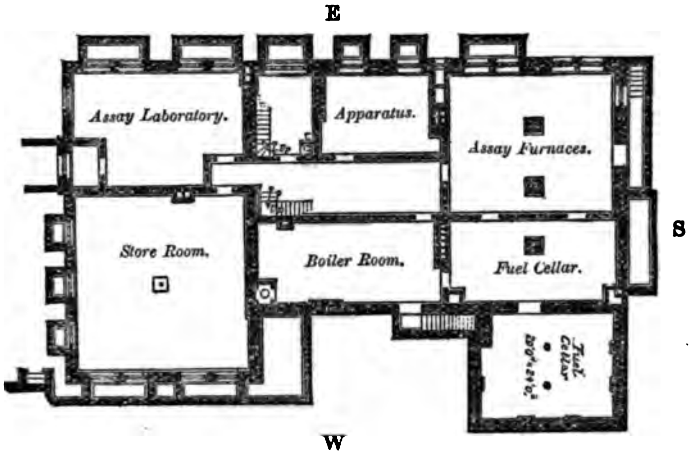
For these experiments it is proposed to use, as a source of electricity in the calorimetric method, fifty Planté cells charged by a small dynamo machine. For measuring large currents of electricity an electrodynamometer has been constructed, with the Helmholtz arrangement of two large coils and a single small suspended coil. The diameter of the large coils is about one metre: that of the small suspended coil is about twenty-five centimetres. There are two sets of large coils,—one wound with

THE NEW CHEMICAL LABORATORY.

The original laboratory for Chemistry was built in the expectation that it would be large enough for a period of e years. At the end of that time there was not room for all who wished to avail themselves of its privileges, and nsequently the Trustees, on June 5, 1882, after much deliberation, decided to enlarge it. Plans were accordingly awn and contracts made, and on the third of May, 1883, the building in its improved and extended form was mpleted and thrown open to public observation. It now covers an area of about fifty by one hundred feet and s three full stories and a basement. In the basement are the necessary conveniences for assaying and other furnace erations; on the first floor there are large rooms devoted mainly to qualitative and quantitative analysis; on the ond, are rooms for research, for the study of the director, the library, and for lectures in General Chemisty. On the ird floor are rooms for the chemical and mineralogical collections, a working and lecture-room for mineralogy and a ond lecture-room for chemistry. The entire laboratory will conveniently accommodate about ninety working students.

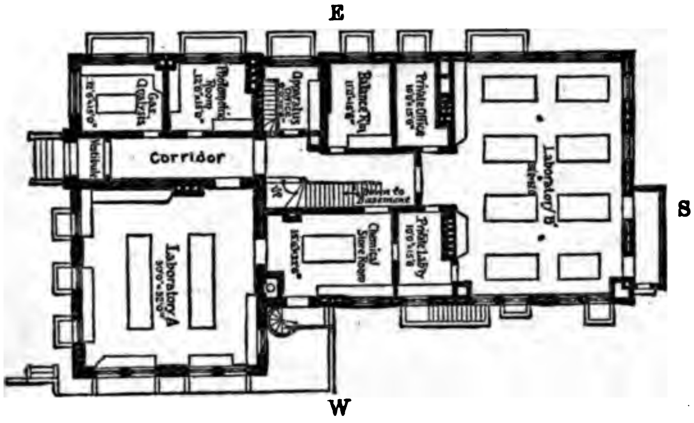
DIAGRAMS SHOWING THE ARRANGEMENT OF ROOMS.

BASEMENT.



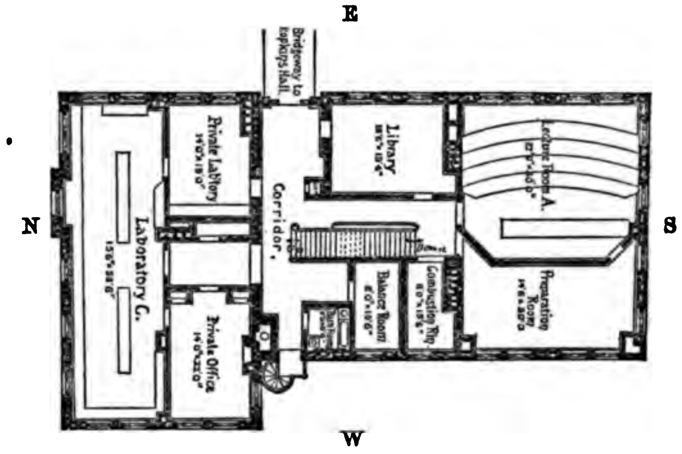
The basement contains store rooms for chemical apparatus, two well hted rooms for assay work and other furnace operations; besides the iler room and fuel vaults.

FIRST FLOOR.



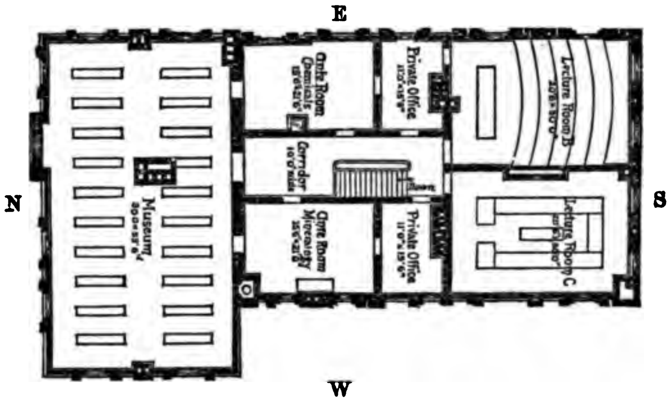
The first floor is devoted mainly to such work as is commonly carried in chemical laboratories. Laboratory A (measuring 30 by 32 feet), intended especially for those who are beginning the study of chemistry; d Laboratory B (measuring 30 by 42 feet). for more advanced stunts, who are engaged in quantitative analysis and in making difficult eparations.

SECOND FLOOR.



The advanced work is carried on in the second floor. Laboratory C (measuring 15.6 by 53.6 feet, and cased with enamelled bricks), is used as the research laboratory. The principal lecture room and the Chemical library as well as the Director's rooms, are also on this floor.

THIRD FLOOR.



The principal room on the third floor (30 by 53.6 feet, in extent) is intended for a cabinet of chemical substances, including examples of industrial processes and results. At present this room also contains a good working collection of minerals. There are also two smaller lecture rooms, one of which is conveniently arranged for instruction in mineralogy.

PUBLIC LECTURES.

(The regulations in regard to the admission of the public to these courses of lectures are given on p. 48 of this *Circular*).

X. CLASSICAL ARCHÆOLOGY.

During the present session special attention will be directed to the subject of Archæology, and several lectures, presenting the different phases of modern inquiry, will be delivered before the students of this university.

I.

An introductory lecture by Dr. **Charles Waldstein**, Director of the Fitzwilliam Museum and University Reader in Classical Archæology in the University of Cambridge, England.

Monday, January 14. On the Influence of Athletic Games on Greek Art.

II.

Four lectures by Mr. J. T. **Clarke**, who has been in charge of the work of the Archæological Institute of America at Assos:

1. *Monday, March 10.* A Plea for Practical Archæology.
2. *Wednesday, March 12.* The Results of the Recent Investigations at Assos, with particular reference to the unpublished work of the last two years. (Illustrated)
3. *Friday, March 14.* The Results of the Recent Investigations at Assos, continued. (Illustrated.)
4. *Monday, March 17.* The Advantages presented by the Cyrenaica as a Field for Archæological Research.

III.

Three lectures by Mr. W. J. **Stillman**:

1. *Wednesday, March 19.* Prehistoric Research in the Classical Field—Greece and its Islands, and Italy.
2. *Friday, March 21.* The State of Research in Greece; recent and desirable researches, with the difficulties to be encountered.
3. *Monday, March 24.* The Relations between Archæology and Art.

Mr. Stillman will meet the Archæological Society, by invitation, while in Baltimore.

IV.

Six lectures by Dr. A. **Emerson**, Fellow in Greek:

1. *Wednesday, March 26.* The Olympian Festival.
2. *Friday, March 28.* Topography of the vicinity of Olympia and History of the Locality to the time of the Completion of the Excavations.
3. *Monday, March 31.* The Description of Pausanias.
4. *Wednesday, April 2.* Chief Architectural Features of the Altis.
5. *Friday, April 4.* The Sculptures of the Temple of Zeus.
6. *Monday, April 7.* Chief Pieces of Free Sculpture: Nike of Paionios; Hermes of Praxiteles.

V.

A concluding Lecture on the Relations of Literary and Plastic Art, on *Wednesday, April 9*, by Professor **Gildersleeve**.

XI. FRENCH LITERATURE.

Professor L. **Rabillon**, Lecturer on French Literature, will give a series of lectures and readings (*in French*), on successive ***Saturdays***, till further notice.

XII. EDUCATION.

Dr. G. **Stanley Hall** will give a course of five public lectures on educational topics in Hopkins Hall on successive ***Tuesdays*** at 5 p. m., beginning Tuesday, March 11.

1. *March 11.* Education in philosophy, its place, importance, and method.
2. *March 18.* The education of defectives:—the blind, deaf-mutes, criminals, the insane, and paupers,—and the light thrown from these sources on the general problems of education.
3. *March 25.* The education of the feelings and sentiments as the central problem of moral education.
4. *April 1.* The old and the new in education, and the relations of the latter to science and philosophy.
5. *April 8.* Mechanism in education and its effects.

Professor **Hiram Corson**'s course of twenty lectures on the Poetry and Drama of the Restoration Period, and the subsequent Drama to Sheridan (see p. 45 of *Circular* 28) was completed on March 7.

J. **Royce**, Ph.D., Instructor in Philosophy in Harvard College, and late Fellow of the Johns Hopkins University, gave two lectures on the Religious Aspect of Philosophy on Thursday, January 31, and Tuesday, February 5.

HISTORICAL LECTURES ON CHEMISTRY.

A course of lectures on selected topics in historical chemistry will be given during the second half-year by the instructors and advanced students in the Chemical Laboratory. The lectures will be given in the main lecture room of the Chemical Laboratory at 9 A. M., on Fridays, beginning Friday, February 8. This course is open to the students in Chemistry only.

I. *Feb. 8, 15.* Two lectures by Mr. D. T. Day, on "The History of the Halogens."

II. *Feb. 22, 29.* Two lectures by Mr. H. N. Stokes, on "The History of Oxygen."

III. *March 7, 14.* Two lectures by Mr. E. H. Keiser, on "The Chemistry of Iron, historically considered."

IV. *March 21, 28.* Two lectures by Dr. J. R. Duggan, on "The History of the Azo and Diazo compounds."

V. *April 4.* One lecture by Dr. G. H. Williams, on "The Relation between Crystalline Form and Chemical Constitution."

VI. *April 11.* One lecture by Mr. A. G. Palmer, on "The History of Benzene."

VII. *April 18.* One lecture by Mr. H. W. Hillyer, on "Stas's Work on Atomic Weights."

VIII. *April 25.* One lecture by Mr. J. E. Talmage, on "The History of the Alkali Metals."

IX. *May 2, 9.* Two lectures by Professor Morse, on "The History of Phosphorus."

X. *May 16, 23.* Two lectures by Professor Remsen, on "The Basicity of Acids."

ENUMERATION OF CLASSES, SECOND HALF-YEAR, 1883-4.

Mathematics. (38 Students).

Classes meet in Rooms 8 and 16.

Mathematical Astronomy: Dr. Story. Three times weekly, Monday, Wednesday, and Friday, 12 m. (2).

Bissing.
Nixon.

Theory of Invariants: Dr. Story. Three times weekly, Monday, Wednesday, and Friday, 10 a. m. (4).

Bissing.
Davis.
Hathaway.
Howell, E. C.

Conic Sections: Dr. Story. Twice weekly, Tuesday and Thursday, 1 p. m. (12).

Ames.
DeWitt.
Dohme.
Eichelberger.
Faerber.
Gilbert.
Gorton.
Horner.
McDaniel.
Outen.
Peed.
Warner.

Higher Plane Curves: Dr. Story. Twice weekly, Tuesday and Thursday, 11 a. m. (2).

Faerber.
Nixon.

Elliptic and Theta Functions; *Cayley, Prym, and others:* Dr. Craig. Three times weekly, Monday, Wednesday, and Friday, 1 p. m. (2).

Daniels.
Nixon.

Partial Differential Equations: Dr. Craig. Twice weekly, Tuesday and Thursday, 10 a. m. (4).

Cajöri.
Davis.
Hathaway.
Nixon.

Elasticity: *Thomson and Lamé:* Dr. Craig. Twice weekly, Monday and Friday, 11 a. m. (3).

Bissing.
Davis.
Hathaway.

Spherical Harmonics and Bessel's Functions: (*Ferrers and Lommel*): Dr. Craig. Weekly, Wednesday, 11 a. m. (4).

Duncan.
Liebig.
Perkins, C. A.
Reid.

Mechanics: Dr. Franklin. Three times weekly, Tuesday, Thursday, and Friday, 10 a. m. (5).

Duncan.
Hall, C. C.
Liebig.
Morrill.
Perkins, C. A.

Total Differential Equations: Dr. Franklin. Twice weekly, Tuesday and Thursday, 11 a. m. (6).

Cajöri.
Crum.
Peed.
Perkins, W. H.
Pratt.
Rieman.

Solid Analytic Geometry: Dr. Franklin. Three times weekly, Monday, Wednesday, and Friday, 11 a. m. (6).

Cajöri.
Crum.
DeWitt.
Faerber.
Peed.
Warner.

Differential and Integral Calculus: Dr. Franklin. Three times weekly, Monday, Wednesday, and Friday, 1 p. m. (14).

Ames.
DeWitt.
Dohme.
Emerson, W. H.
Gilbert.
Gorton.
Haldeman.
Hillyer.
Horner.
McDaniel.
Outen.
Palmer.
Rieman.
Warner.

Physics. (40 Students.)

Classes meet in Rooms, 3, 4, 7, 8, and 9.

Heat Conduction: Professor Rowland. Four times weekly, Monday, Tuesday, Thursday, and Friday, 9 a. m. (8).

Davis.
Duncan.
Hathaway.
Kimball.
Liebig.
Morrill.
Perkins, C. A.
Reid.

This course will be followed by a course in Physical Optics.

Laboratory Work: Professor Rowland. Daily. (10 advanced students.)

Duncan.
Goodnow.
Kimball.
Liebig.
Morrill.
Perkins, C. A.
Pratt.
Reid.
Rieman.

Major Course: Dr. Hastings. Lecture, once weekly, Thursday, 4 p. m. Laboratory work daily, especially Tuesdays. (13).

Cajöri.
Crum.
Day, D. T.
Emerson, W. H.
Hall, C. C.
Hathaway.
Keiser.
Nixon.
Peed.
Pratt.
Rieman.
Warner.
Webster.

General Physics: *Minor Course:* Dr. Hastings. Daily, 10 a. m. (19).

Ames.
Buckler.
Canfield.
Eichelberger.
Gorton.
Hartogensis.
Horner.
Laessig.
Lyons.
McDaniel.
Outen.
Penniman, G. D.
Penniman, W. B. D.
Perkins, W. H.
Pleasants, R. H.
Roberts, D. E.
Waltemeyer.
Winslow.
Woods.

Laboratory Work: (*Class in General Physics*): Dr. Hastings and Mr. Reid. (19).

Ames.
Buckler.
Canfield.
Eichelberger.
Gorton.
Hartogensis.
Horner.
Laessig.
Lyons.
McDaniel.
Outen.
Penniman, G. D.
Penniman, W. B. D.
Perkins, W. H.
Pleasants, R. H.
Roberts, D. E.
Waltemeyer.
Winslow.
Woods.

Chemistry. (46 Students.)

Classes meet in the Chemical Laboratory.

Laboratory Work: Professor Remsen and Dr. Morse: Daily. (46).

Applegarth.
Bayley.
Boyd.
Brackett.
Campbell.
Canfield.
Coale.
Collins.
Day, D. T.
Dinsmore.
Duggan.
Edmond.
Emerson, W. H.
Gilbert.
Gordon.
Hartogensis.
Hillyer.
Hinkley.
Johnston.
Keiser.
Laessig.
Miller, E. G.
Miller, J. S.
Orndorff.
Palmer.
Piggot.
Pleasants, J.
Ramsburg.
Rieman.
Roberts, D. E.
Ryttenberg.
Sanger.
Schaeffer.
Schubart.
Simpson.
Slack.
Smedes.
Stamps.
Steiner.
Stevens.
Stokes, H. N.
Talmage.
Walz.
Webster.
Wylie.
Yonce.

Chemistry of Carbon Compounds: Professor Remsen. Daily, 9 a. m. (17.)

Bayley.
Boyd.
Campbell.
Collins.
Edmond.
Hillyer.
Johnston.
Laessig.
Orndorff.
Piggot.
Schaeffer.
Schubart.
Smedes.
Stamps.
Stevens.
Talmage.
Webster.

General Chemistry: Dr. Morse. Daily, 9 a. m. (17).

Brackett.
Canfield.
Emerson, W. H.
Gilbert.
Gordon.
Hartogensis.
Hinkley.
Miller, E. G.
Miller, J. S.
Pleasants, J.
Ramsburg.
Rieman.
Ryttenberg.
Slack.
Steiner.
Walz.
Wylie.

Mineralogy: Dr. Williams. Lectures three times weekly, Monday, Wednesday, and Friday, 4 p. m., and practical work, Saturday, 9 a. m. to 12 m. (6).

Bayley.
Collins.
Palmer.
Piggot.
Sanger.
Yonce.

The course in Mineralogy will be succeeded by a course in General Geology.

Biology. (36 Students.)

Classes meet in the Biological Laboratory.

Laboratory Work: Professor Martin, Dr. Brooks, and Mr. Donaldson. Daily, 9. a. m. to 5 p. m. (32).

Abel.
Andrews.
Beyer.
Boyd.
Bruce, A. T.
Campbell.
Dolley.
Donaldson, F.
Duggan.
Edmond.
Friedenwald.
Haldeman.
Hanna.
Howell, W. H.
Jastrow.
Jayne.
Kemp.
Lee.
Lord, J. W.
Macallum.
McClintock.
Miller, J. S.
Nachtrieb.
Nelson.
Osborn, H. L.
Roberts, B. T.
Steele, S. T.
Stevens.
Talmage.
Thomas, H. M.
Webster.
Wilson, H. V.

General Biology: Professor Martin. Three times weekly, Monday, Tuesday, and Thursday, 11 a. m. (21).

Abel.
Andrews.
Beyer.
Boyd.
Bruce, A. T.
Campbell.
Dolley.
Duggan.
Edmond.
Haldeman.
Hanna.
Jayne.
Macallum.
McClintock.
Miller, J. S.
Nelson.
Roberts, B. T.
Slack.
Steele, S. T
Talmage.
Webster.

Animal Physiology and Histology: Professor Martin. Three times weekly, Monday, Wednesday, and Friday, 10 a. m. (14).

Abel.
Andrews.
Beyer.
Bruce, A. T.
Friedenwald.
Hanna.
Jastrow.
Jayne.
Kemp.
Lord, J. W.
Macallum
McClintock.
Nelson.
Wilson, H. V.

Comparative Osteology: Mr. Conn. Twice weekly, Wednesday and Friday, 11 a. m. (11).

Andrews.
Beyer.
Boyd.
Campbell.
Haldeman.
Hanna.
McClintock.
Miller, J. S.
Nelson.
Roberts, B. T.
Talmage.

Principles of Morphology: Dr. Brooks. Twice weekly, Monday and Thursday, 9 a. m. (17).

Andrews.
Beyer.
Bruce, A. T.
Conn.
Dolley.
Hanna.
Howell, W. H.
Jayne.
Kemp.
Lee.
Macallum.
McClintock.
Nachtrieb.
Nelson.
Osborn, H. L.
Stevens.
Wilson, H. V.

Physiological Psychology: Dr. Hall. Twice weekly, Tuesday and Thursday, 10 a. m. (21).

Abel.
Andrews.
Beyer.
Bruce, A. T.
Dewey, J.
Donaldson, H. H.
Friedenwald.
Hartwell.
Howell, W. H.
Jastrow.
Kemp.
Lee.
Lord, J. W.
Macallum.
McClintock.
Miller, J. S.
Nelson.
Osborn, H. L.
Stevens.
Talmage.
Wilson, H. V.

(This course is also enumerated under Psychology).

Greek. (37 Students.)

Classes meet in 181 N. Howard St.

Seminary: Professor Gildersleeve. Twice weekly, Monday and Wednesday, 12 m. (16).

Arnolt.
Emerson, A.
Huizinga.
Lodge.
Miller, C. W. E.

Baden.
Bothne.
Elmer.
Glenn, W. L.
Graves.
Holstad.
Pease.
Slaughter.
Stout.
Wiggins.
Williams, W. H.

Historiography: Professor Gildersleeve. Weekly, Thursday, 12 m. (16.)

Arnolt.
Baden.
Bothne.
Elmer.
Emerson, A.
Glenn, W. L.
Graves.
Holstad.
Huizinga.
Lodge.
Miller, C. W. E.
Pease.
Slaughter.
Stout.
Wiggins.
Williams, W. H.

Lucian: Professor Gildersleeve. Weekly, Tuesday, 10 a. m. (14).

Arnolt.
Bothne.
Elmer.
Emerson, A.
Glenn, W. L.
Graves.
Holstad.
Huizinga.
Lodge.
Miller, C. W. E.
Pease.
Slaughter.
Stout.
Wiggins.

Syntax of the Noun: Professor Gildersleeve. Weekly, Friday, 10 a. m. (15).

Arnolt.
Bothne.
Elmer.
Emerson, A.
Glenn, W. L.
Graves.
Holstad.
Huizinga.
Lodge.
Miller, C. W. E.
Pease.
Slaughter.
Stout.
Wiggins.
Zweizig.

Sophocles: *Philoctetes;* ***Aristophanes:*** *Ranae:* Professor C. D. Morris. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 12 m. (10).

Bevan.
Fink.
Fossum.
Glenn, J.
Howard.
Loane.
McLane.
Roberts, B. T.
Walz.
Wilkens.

Homer: *Iliad:* Professor C. D. Morris. Weekly, Friday, 9 a. m. (3).

Egge.
Fossum.
Tolman.

Homer: *Odyssey IX-XII;* ***Euripides:*** *Alcestis:* Dr. Spieke
Four times weekly, Tuesday, Wednesday, Thursday, and Frida
11 a. m. (8).

Fossum.
Harry.
Hodges.
Horner.
Hough.
Stein.
Williams, L.
Williams, W.

Patristic Greek: *Shepherd of Hermas:* Mr. Harris. Twi
weekly, Tuesday and Thursday, 9 a. m., 187 N. Howard St. (3).

Bevan.
Glenn, W. L.
Williams, W. H.

Greek Inscriptions: Dr. Emerson. Weekly, Tuesday, 12 m. (

Arnolt.
Huizinga.
Lodge.
Miller, C. W. E.
Stout.

Pausanias: Dr. Emerson. Weekly, Friday, 12 m. (Aft
March twice a week). (8).

Arnolt.
Bothne.
Elmer.
Huizinga.
Lehmann.
Lodge.
Pease.
Slaughter.

Prose Composition:

Class A: Professor C. D. Morris. Weekly, Monday, 12 m. (10

Bevan.
Fink.
Fossum.
Glenn, J.
Howard.
Loane.
McLane.
Roberts, B. T.
Walz.
Wilkens.

Class B: Dr. Spieker. Weekly, Monday, 11 a. m. (8).

Fossum.
Harry.
Hodges.
Horner.
Hough.
Stein.
Williams, L.
Williams, W.

Latin. (39 Students.)

Classes meet in 181 N. Howard St.

Seminary: *Terence:* Dr. Warren. Twice weekly, Tuesday a
Friday, 11 a. m. (14).

Baden.
Bothne.
Elmer.
Glenn, W. L.
Graves.
Holstad.
Lodge.
Miller, C. W. E.
Pease.
Slaughter.
Stout.
Thayer.
Wiggins.
Zweizig.

Epigraphy: Dr. Warren. (12).

Bothne.
Elmer.
Emerson, A.
Glenn, W. L.
Graves.
Holstad.
Miller, C. W. E.
Pease.
Slaughter.
Stout.
Wiggins.
Zweizig.

Juvenal: Dr. Warren. Four times weekly, Tuesday, Wednesda
Thursday, and Friday, 10 a. m. (8).

Fink.
Fossum.
Glenn, J.
McLane.
Pleasants, J.
Roberts, B. T.
Walz.
Wilkens.

The meetings on Wednesday are devoted to reading Latin at sight.

Tacitus: *Agricola, Germania, and Annals II.* Professor C. Morris. Four times weekly, Tuesday, Wednesday, Thursday, a
Friday, 10 a. m. (10).

Bevan.
Doub.
Egge.
Frederick.
Loane.
Price.
Stein.
Tatlock.
Williams, L.
Williams, W.

Horace: *Odes:* Dr. Spieker. Three times weekly, Tuesday, W
nesday, and Friday, 9 a. m. *Satires:* Dr. Warren. Week
Thursday, 9 a. m. (8).

English.
Harry.
Hodges.
Hough.
Howard.
Price.
Stein.
Woods.

Classical Antiquities: Dr. Emerson. Twice weekly, Tuesd
and Thursday, 4 p. m. (2).

Pease.
Wilkens.

Prose Composition:

Class A: Dr. Warren. Weekly, Monday, 10 a. m. (6).

Glenn, J.
McLane.
Pleasants, J.
Roberts, B. T.
Walz.
Wilkens.

Class B: Professor Morris. Weekly, Monday, 10 a. m. (5).

Bevan.
Frederick.
Loane.
Stein.
Tatlock.

Class C: Dr. Spieker. Weekly, Monday, 9 a. m. (10).

Doub.
English.
Harry.
Hodges.
Hough.
Howard.
Price.
Williams, L.
Williams, W.
Woods.

Shemitic Languages. PROFESSOR HAUPT. (11 students.)

Classes (except Assyriological Exercises) meet in the Oriental Seminary, 113 W. Monument St.

Hebrew: *Genesis.* Twice weekly, Tuesday and Wednesday, 4 p. m. (9).

Adler.
Arnolt.
Frothingham.
Grape.
Harris.
Huizinga.
Lehmann.
Philipson.
Williams, W. H.

Arabic: *Petermann's Chrestomathy.* Weekly, Tuesday, 3 p. m. (6).

Adler.
Arnolt.
Frothingham.
Huizinga.
Lehmann.
Philipson.

Ethiopic: *Narratiunculae de Viris Sanctis in Dillmann's Chrestomathia Aethiopica.* Weekly, Wednesday, 3 p. m. (5).

Adler.
Arnolt.
Frothingham.
Lehmann.
Philipson.

Assyrian: *Egyptian Campaigns of Sardanapalus (Cuneiform Inscriptions of Western Asia, Vol. V, pl. 1 and 2.)* Weekly, Thursday, 3–5 p. m. (7).

Adler.
Arnolt.
Chilton.
Frothingham.
Lehmann.
O'Connor.
Philipson.

Sumero-Akkadian: *Bilingual cuneiform Syllabaries and Vocabularies in Haupt's Keilschrifttexte.* Weekly, Tuesday and Thursday, 2 p. m. (7).

Adler.
Arnolt.
Chilton.
Frothingham.
Lehmann.
O'Connor.
Philipson.

Assyriological Exercises for advanced Assyriologists: *Proto-Chaldean Incantations and Penitential Psalms.* Two hours weekly, Friday, 8–10 p. m. 163 St. Paul St. (1).

Lehmann.

Sanskrit and the comparative grammar of the cognate languages. DR. BLOOMFIELD. (16 Students).

Sanskrit: *(First Year): Whitney's Grammar and the Interpretation of Nala.* Twice weekly, Tuesday, 11 a. m., Friday, 12 m., 113 W. Monument St. (5).

Adler.
Huizinga.
Jagemann.
Tolman.
Williams, W. H.

Sanskrit *(Advanced): Çakuntala.* Weekly, Saturday, 10–12, 113 W. Monument St. (3).

Spieker.
Thayer.
Todd.

Veda: *Rig-Veda:* Weekly, Wednesday, 10 a. m., 113 W. Monument St. (3).

Lehmann.
Spieker.
Todd.

Practical Sanskrit Exercises: *Bühler, Leitfaden für den Elementarcursus des Sanskrit.* Weekly, Friday, 3 p. m., 113 W. Monument St. (9).

Adler.
Huizinga.
Jagemann.
Lehmann.
Spieker.
Thayer.
Todd.
Tolman.
Williams, W. H.

Comparative Philology: *Whitney, Language and the Study of Language; Lectures:* Weekly, Monday, 4 p. m., 181 N. Howard St. (11).

Adler.
Arnolt.
Bothne.
Egge.
Fossum.
Glenn, W. L.
Huizinga.
Jagemann.
Tolman.
Wilkens.
Wright.

German. (50 Students.)

Gothic: DR. DIPPOLD. Weekly, Monday, 9 a. m., 187 N. Howard St. (4).

Cobb.
Dunlap.
Egge.
Fossum.

Middle High German: *Weinhold's Reader:* DR. DIPPOLD. Twice weekly, Monday, 11 a. m. and Thursday, 9 a. m., 187 N. Howard St. (2).

Egge.
Wright.

Stilübungen and Syntax: MR. RADDATZ. Second Thursday of each month, 2.30 p. m., room A, 111 W. Monument St. (8).

Artz.
Cromwell.
DeWitt.
Dohme.
Egge.
Hartogensis.
Miller, E. G.
Stokes, G. C.

German Literature *(Lectures in German):* DR. DIPPOLD. Alternate Saturdays, 11 a. m., 111 W. Monument St. (14).

Andrews.
Artz.
Bowen.
Conn.
Cromwell.
DeWitt.
Dohme.
Egge.
Gates.
Glenn, J.
Laessig.
Miller, E. G.
Stokes, G. C.
Wright.

(Major Course).

Goethe: *Wilhelm Meister; Hermann and Dorothea:* DR. DIPPOLD. Three times weekly, Monday, Tuesday, and Wednesday, 10 a. m., 111 W. Monument St. (6).

Artz.
Cromwell.
DeWitt.
Dohme.
Miller, E. G.
Stokes, G. C.

Lessing: *Emilia Galotti; Reading at sight:* DR. DIPPOLD. Weekly, Friday, 10 a. m., 111 W. Monument St. (6).

Artz.
Cromwell.
De Witt,
Dohme.
Miller, E. G.
Stokes, G. C.

Prose Composition: MR. RADDATZ. Weekly, Wednesday, 2.30 p. m. Room A, 111 W. Monument St. (10)

Artz.
Cromwell.
De Witt.
Dohme.
Friedenwald.
Gates.
Hartogensis.
Miller, E. G.
Perkins, W. H.
Stokes, G. C.

[The Goethe and Schiller Society meets, under the direction of Dr. Dippold, on the second Friday of each month, at 3 p. m., in 111 W. Monument St. Essays on Goethe's Faust, Lessing's Nathan, etc., are read and discussed. (6).

Artz.
Cromwell.
De Witt.
Dohme.
Miller, E. G.
Stokes, G. C.]

(Minor Course.)

Schiller: *Don Carlos:* DR. DIPPOLD. Weekly, Wednesday, 11 a. m., 111 W. Monument St. (18).

Ames.
Eichelberger.
Fifield, J. C.
Fink.
Gilbert.
Gorton.
Lord, J. D.
Lyons.
McDaniel.
Penniman, W. B. D.
Price.
Smedes.
Smith.
Stow.
Waltemeyer.
Wiegand.
Wingert.
Winslow.

Lessing: *Minna von Barnhelm:* DR. DIPPOLD. Twice weekly, Tuesday and Thursday, 11 a. m., 111 W. Monument St. (19).

Ames.
Burton.
Cobb.
Eichelberger.
Fifield, J. C.
Fink.
Gilbert.
Gorton.
Lord, J. D.
Lyons.
Price.
Penniman, W. B. D.
McDaniel.
Smith.
Stow.
Wingert.
Wiegand.
Waltemeyer.
Winslow.

Historical: *Erler's Deutsche Geschichte:* DR. DIPPOLD. Weekly, Friday, 11 a. m., 111 W. Monument St. (21).

Ames.
Buckler.
Doub.
Eichelberger.
English.
Fifield, J. C.
Fink.
Gilbert.
Gorton.
Lord, J. D.
Lyons.
McDaniel.
Penniman, W. B. D.
Price.
Ramage.
Smith.
Stow.
Waltemeyer.
Wiegand.
Wingert.
Winslow.

Second Section: *Schiller: Die Piccolomini; Wallenstein's Tod:* DR. DIPPOLD. Thrice weekly, Monday, Tuesday, and Wednesday, 2.30 p. m., 187 N. Howard St. (11).

Brackett.
Buckler.
Burton.
Cobb.
Doub.
Dunlap.
English.
Lamb.
Outen.
Slaughter.
Williams, W. K.

Prose Composition: MR. RADDATZ. Weekly, Friday, 2.30 p. m., Room A, 111 W. Monument St. (22).

Ames.
Doub.
Eichelberger.
Ellinger.
English.
Fifield, J. C.
Fink.
Gilbert.
Gorton.
Lord, J. D.
Lyons.
McDaniel.
Penniman, W. B. D.
Price.
Riddick.
Slaughter.
Smith.
Stow.
Waltemeyer.
Wiegand.
Wingert.
Winslow.

Romance Languages. (22 Students.)

Classes meet in 187 N. Howard St. and 111 W. Monument St.

Advanced Courses: *Anglo-Norman* (*Chardry's Josaphaz*); *Provençal Literature* (*xii century extracts*); *Portuguese* (*Camoës, Os Lusiadas*): *Old French* (*Aucassin et Nicolete*). MR. ELLIOTT. Four times weekly, Monday, Wednesday, and Thursday, 10 a. m., and Thursday, 9 a. m. (4).

Bowen.
Fontaine.
Jagemann.
Warren, F. M.

Advanced Courses: *Spanish and Portugese Dialects: Comparative Grammar of the Romance Languages: Ladinian* (*xvi and xvii century selections*). MR. ELLIOTT. Three times weekly, Monday, Wednesday, and Thursday, 11 a. m. (5).

Bowen.
Fontaine.
Jagemann.
Todd.
Warren, F. M.

French Philology, Phonetics, etc.: MR. ELLIOTT. Weekly, Monday, 9 a. m. (7).

Bevan.
Bowen.
Fink.
Fontaine.
Lyons.
Warren, F. M.
Wiegand.

Italian: *Goldoni* (*Comedies*): *Dante* (*Inferno*): MR. TODD. Three times weekly, Monday, Tuesday, and Wednesday, 9 a. m. (6).

Bowen.
Fink.
Fontaine.
Perkins, W. H.
Warren, F. M.
Wilkens.

Spanish: *Knapp's Spanish Readings:* MR. TODD. Twice weekly, Thursday and Friday, 9 a. m. (6).

Bowen.
Fontaine.
Lord, J. D.
Lord, J. W.
Perkins, W. H.
Warren, F. M.

French: Major Course: *Old French Literature* (*Bartsch's Chrestomathy*): *Corneille* (*Cid*): MR. TODD. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 1 p. m. (7).

Bevan.
Bowen.
Fink.
Fontaine.
Lyons.
Warren, F. M.
Wiegand.

French: Minor Course: *Dumas, Voltaire, Milne-Edwards:* MR. TODD. Daily, 12 m. (10).

Carey.
Crum.
Fifield, J. C.
Frederick.
Hinkley.
Laessig.
Lord, J. W.
Penniman, W. B. D.
Pleasants, R. H.
Stow.

One exercise weekly of both the French Major and Minor Courses is devoted to Prose Composition. Classes for French Conversation also meet daily.

English. (41 Students).

Unless otherwise specified, classes meet in 111 W. Monument St.

General English Philology. Regular meetings of the advanced students are held under the direction of DR. WOOD, bi-weekly, Monday, 8–10 p. m. (10).

Alden.
Brice.
Burton.
Cobb.
Crum.
Dunlap.
Egge.
Jagemann.
Tolman.
Wright.

Anglo-Saxon: *Advanced Course: Grein: Bibliothek der angelsächs. Poesie I.* DR. WOOD. Twice weekly, Monday and Wednesday, 10 a. m. (4).

Crum.
Egge.
Tolman.
Wright.

(*Major Course.*)

Anglo-Saxon: *Sweet's Reader: Cynewulf's Elene:* DR. WOOD. Twice weekly, Monday and Wednesday, 12 m. (7).

Alden.
Brice.
Burton.
Cobb.
Dunlap.
Gates.
Stein.

Early English: 1200–1350 A. D.: *Morris and Skeat's Specimens,* (*Pt. II. finished*); *Pt. I.:* DR. WOOD. Twice weekly, Tuesday and Friday, 12 m. (8).

Alden.
Brice.
Burton.
Cobb.
Dunlap.
Egge.
Gates.
Stein.

(*Minor Course.*)

History of the English Language: MR. TOLMAN. *Lounsbury's History, and Marsh's Lectures.* Weekly, Monday, 11 a. m. (6).

Brice.
Burton.
Cromwell.
Dunlap.
Gates.
Wilkens.

Early English: *Chaucer:* DR. WOOD. Weekly, Wednesday, 11 a. m. (9).

Alden.
Brice.
Burton.
Cobb.
Cromwell.
Dunlap.
Gates.
Stein.
Wilkens.

English Prose Writers: DR. BROWNE. Twice weekly, Tuesday and Thursday, 11 a. m. (8).

Brice.
Burton.
Cobb.
Cromwell.
Dunlap
Egge.
Gates.
Wilkens.

Grammatical and Rhetorical Exercises: DR. WOOD. Weekly, Friday, 11 a. m. (6).

Brice.
Burton.
Cromwell.
Egge.
Gates.
Wilkens.

English Literature; *At the end of the 15th and beginning of the 16th century.* (Four class lectures.) DR. WOOD. Weekly, Thursday, 10 a. m. (10).

Alden.
Brice.
Burton.
Cobb.
Crum.
Dunlap.
Egge.
Gates.
Tolman.
Wright.

This course will be followed by a series of lectures, accessible to any member of the university, on English Writers in the period 1500–1580 A. D. The time and place of meeting, with list of subjects, will be announced later.

English Literature: (*P. H E. Course*): DR. BROWNE. Twice weekly, Wednesday and Thursday, 12 m., Hopkins Hall. (27).

Ames.
Bayard.
Buckler.
Doub.
Dohme.
Eichelberger.
English.
Friedenwald.
Gorton.
Harry.
Hartogensis.
Hodges.
Horner.
Hough.
McDaniel.
Orndorff.
Price.
Pleasants, R. H.
Riddick.
Smith.
Waltemeyer.
Williams, L.
Williams, W. K.
Wingert.
Winslow.
Woods.
Wylie.

English Literature: PROFESSOR CORSON. Three times weekly, Monday, Wednesday, and Friday, 5. p. m., in the smaller lecture room of the Peabody Institute. Twenty public lectures on the Poetry and Drama of the Restoration Period.

History and Political Science. (75 Students).

Classes meet in Bluntschli Library and adjacent Rooms.

Seminary: DR. ADAMS. Weekly, Friday, 8–10 p. m. (26).

Alden.
Berry.
Dewey, D. R.
Dewey, J.
Fisher.
Goodman.
Gould.
Holcomb.
Ingle.
Johnson, J.
Levermore.
Ramage.
Randall.
Rich.
Robinson.
Rose.
Sato.
Scaife.
Shaw.
Shinn.
Sollers.
Steel, W. B.
Wilhelm.
Wilson, W.
Worthington.
Yager.

American History: DR. ADAMS. Weekly, Thursday, 12 m. (20).

Alden.
Berry.
Dewey, D. R.
Fisher.
Gould.
Holcomb.
Ingle.
Levermore.
Ramage.
Randall.
Rich.
Sato.
Scaife.
Shaw.
Shinn.
Steel, W. B,
Wilhelm.
Wilson, W.
Worthington.
Yager.

The Renaissance: DR. ADAMS. Twice weekly, Monday and Tuesday, 11 a. m. (21).

Alden.
Applegarth.
Artz.
Bayard.
Dawson.
Drain.
Fisher.
Fossum.
Glenn, J.
Glenn, W. L.
Howard.
Holcomb.
McLane.
Pleasants, R. H.
Randall.
Riggs.
Ryttenberg.
Steiner.
Steel, W. B.
Warren, F. M.
Worthington.

International Law and European Politics: DR. ADAMS. Three times weekly, Monday, Tuesday, and Wednesday, 12 m. (22).

Artz.
Berry.
Dewey, D. R.
Drain.
Fisher.
Gould.
Holcomb.
Ingle.
Lyons.
Ramage.
Randall.
Rich.
Sato.
Scaife.
Shaw.
Shinn.
Steel, W. B.
Stokes, G. C.
Wilhelm.
Wilson, W.
Worthington.
Yager.

Political Economy: *Advanced Course:* DR. ELY. Three times weekly, Monday, Wednesday, and Friday, 4 p. m. (18).

Berry.
Brice.
Dewey, D. R.
Gould.
Holcomb.
Ingle.
Levermore.
Ramage.
Randall.
Rich.
Sato.
Shaw.
Shinn.
Steel, W. B.
Wilhelm.
Wilson, W.
Worthington.
Yager.

English Constitutional History: Stubbs' Select Charters: DR. JAMESON. Weekly, Tuesday, 4 p. m. (6).

Artz.
Levermore.
Lyons.
Randall.
Stokes, G. C.
Worthington.

English and French History: DR. JAMESON. Three times weekly, Wednesday, Thursday, and Friday, 11 a m. (11).

Applegarth.
Artz.
Bayard.
Drain.
Howard.
McLane.
Pleasants, R. H.
Randall.
Riggs.
Ryttenberg.
Steiner.

Elements of Political Economy and Historical Systems of Political Economy: *Mill's Political Economy and Lectures.* DR. ELY. Daily, 1 p. m. (15).

Applegarth.
Artz.
Carey.
Dawson.
Drain.
Fossum.
Hinkley.
Howard.
Hughes.
Lord, J. W.
Miller, E. G.
Penniman, G. D.
Price.
Riggs.
Scaife.

Classical History: *(P. H. E. Course):* DR. JAMESON. Twice weekly, Tuesday and Friday, 12 m. (26).

Ames.
Bayard.
Buckler.
Dohme.
Doub.
Eichelberger.
English.
Gorton.
Harry.
Hartogensis.
Hodges.
Horner.
Hough.
McDaniel.
Orndorff.
Pleasants, R. H.
Price.
Riddick.
Smith.
Waltemeyer.
Williams, L.
Williams, W. K.
Wingert.
Winslow.
Woods.
Wylie.

Historical and Physical Geography: *(P. H. E. Course):* DR. JAMESON. Weekly, Monday, 12 m. (27).

Ames.
Bayard.
Buckler.
Dohme.
Doub.
Eichelberger.
English.
Gorton.
Harry.
Hartogensis.
Hodges.
Horner.
Hough.
McDaniel.
Orndorff.
Pleasants, R. H.
Price.
Riddick.
Smith.
Stein.
Waltemeyer.
Williams L.
Williams, W. K.
Wingert.
Winslow.
Woods.
Wylie.

ogic, etc. MR. PEIRCE. (7 Students).

Logic: Twice weekly, Monday, 11 a. m., Friday, 9 a. m., 187 N. Howard St. (2).

Jastrow.
Taber.

Probabilities. Twice weekly, Monday and Wednesday, 9 a. m. Room 16. (7).

Davis.
Faerber.
Hathaway.
Jastrow.
Nixon.
Story.
Taber.

sychology. DR. G. STANLEY HALL, (33 Students).

Psychological and Ethical Theories. Twice weekly, Monday and Wednesday, 12 m., 181 N. Howard St. (9).

Dewey, J.
Edmond.
Fisher.
Jastrow.
Miller, J. S.
Penniman, G. D.
Ryttenberg.
Steiner.
Webster.

Physiological Psychology. Twice weekly, Tuesday and Thursday, 10 a. m., Biological Laboratory. (21).

Abel.
Andrews.
Beyer.
Bruce, A. T.*
Dewey, J.
Donaldson, H. H.*
Friedenwald.*
Hartwell.*
Howell, W. H.
Jastrow.*
Kemp.*
Lee.
Lord, J. W.
Macallum.
McClintock.
Miller, J. S.
Nelson.
Osborn, H. L.
Stevens.*
Talmage.
Wilson, H. V.

* Engaged also in observation and experiment.

(This course is also enumerated under Biology).

Practical Ethics: *(L. E. P. Course).* MR. HARRIS. Three times weekly, Monday, Wednesday, and Friday, 1 p. m. (6).

Campbell.
Kemp.
Loane.
Lord, J. D.
Orndorff.
Stokes, G. C.

Dr. Hall will begin, early in April, a course of lectures on Mental Hygiene, designed for undergraduates.

Elocution. (49 Students.)

MR. WOODWORTH. Daily, 10 a. m. to 2 p. m., Hopkins Hall.

Alden.
Artz.
Bayard.
Bevan.
Bowen.
Canfield.
Cobb.
Doub.
Dewey, J.
Dixon.
Dohme.
English.
Fifield, J. C.
Fisher.
Frederick.
Frothingham.
Gates.
Gerber, A.
Glenn, W. L.
Harry.
Hodges.
Kennard.
Lee.
Laessig.
Loane.
Lodge.
Lyons.
Orndorff.
Osborn, H. L.
Pease.
Penniman, G. D.
Perkins, W. H.
Pleasants, J.
Price.
Ramage.
Roberts, B. T.
Scaife.
Slaughter.
Stein.
Stokes. G. C.
Tatlock.
Tolman.
Waller.
Wiegand.
Wilhelm.
Williams, L.
Williams, W. K.
Wingert.
Woods.

Drawing. (29 Students.)

MR. NEWELL. Five times weekly, Monday, Tuesday, Thursday, Friday, and Saturday, 1–5 p. m. (29).

(Free-Hand Drawing).

Andrews.
Campbell.
Carey.
Dohme.
English.
Glenn, J.
Haldeman.
Hartogensis.
Hillyer.
Hodges.
Howell, W. H.
Jayne.
Laessig.
Lee.
Nachtrieb.
Nelson.
Osborn, H. L.
Penniman, G. D.
Perkins, W. H.
Pleasants, J.
Randall.
Smith.
Thomas, B. V.
Waltemeyer.
Winslow.

(Mechanical Drawing).

Crum.
Eichelberger.
Gorton.
McDaniel.

Educational Lectures.

Graduate Course. Weekly, Saturday, 10 a. m., in the Chemical Lecture Room. This course is designed for the Fellows and other Graduate Students looking forward to educational and scientific careers. The following have enrolled themselves:

Arnolt.
Bissing.
Bothne.
Bruce.
Burton.
Coale.
Cobb.
Conn.
Day.
Dewey, D. R.
Dewey, J.
Donaldson, H. H.
Duggan.
Dunlap.
Egge.
Elmer.
Emerson, A.
Fisher.
Fossum.
Frothingham.
Gould.
Graves.
Hanna.
Hartwell.
Holcomb.
Howell, W. H.
Huizinga.
Ingle.
Jagemann.
Keiser.
Lee.
Lehmann.
Liebig.
Lodge.
Macallum.
MacClintock.
McDaniel.
Miller, C. W. E.
Nachtrieb.
Nelson.
Outen.
Osborn, H. L.
Perkins, C. A.
Peed.
Reid.
Rieman.
Sanger.
Sato.
Schubart.
Sollers.
Spieker.
Stevens.
Stokes, H. N.
Thayer.
Todd.
Tolman.
Webster.
Wiggins.
Williams, W. H.
Wilson, H V.
Wright.
Yonce.

(See statement of this course on page 32 of Circular 28).

Public Course. DR. G. STANLEY HALL. Weekly, in Hopkins Hall, Tuesdays, 5 p. m., March 11 to April 8. (See p. 64).

MEETINGS OF UNIVERSITY SOCIETIES.

Scientific Association. Monthly, First Wednesday, 8 p. m.
Philological Association. Monthly, First Friday, 12 m.
Historical and Political Science Association. Weekly, Friday, 8 p. m.
Mathematical Society. Monthly, Third Wednesday, 8 p. m.
Metaphysical Club. Monthly, Second Tuesday, 8 p. m.
Archæological Society. As announced from time to time.
Naturalists' Field Club. As announced from time to time

PROCEEDINGS OF SOCIETIES.

Scientific Association.

January 9.—Fifty-fourth regular meeting. Professor Martin in the chair. Thirty members present.

Papers read:

Five Minutes on the Solar Spectrum, by H. A. Rowland.

Note on Auroras, by H. F. Reid.

A Notation for Binary Arithmetic and its Use, by W. E. Story.

Note on the Action of Heat on Ethylene, by D. T. Day.

February 9.—Fifty-fifth regular meeting. Professor Martin in the chair. Thirty-five members present.

Papers read:

On the Dynamic Theory of Diffraction, by H. A. Rowland.

On an Infusorian recently observed in Baltimore Water, by C. S. Dolley. (*Abstract on p.* 60).

Resumé of Some Recent Work on the Brain, by H. H. Donaldson.

Philological Association.

January 4.—Fifty-first regular meeting. Professor Gildersleeve in the chair. Thirty-three members present.

Papers read:

On a Proposed Edition of the Kâuçika-sûtra of the Atharva Veda. (Position of the text in Vedic literature; contents and materials for the edition), by M. Bloomfield. (*Abstract on p.* 52).

On the Rights of a Greek Metropolis over its Colonies, by C. D. Morris. (*Abstract on p.* 55).

Notes on the Sinaitic and Vatican Codices, by J. R. Harris. (*Abstract on p.* 56).

February 1.—Fifty-second regular meeting. Professor Gildersleeve in the chair. Thirty-seven members present.

Papers read:

On the Greek Final Sentence, by B. L. Gildersleeve.

Note on Plautus Mercator, v. 524 f., by M. Warren. (*Abstract on p.* 56).

On Musical Notation in the Study of Blank Verse, by A. S. Tolman. (*Abstract on p.* 56).

Historical and Political Science Association.

January 4.—Dr. H. B. Adams in the chair.

Papers read:

The Study of Roman Law and History, by W. B. Scaife. (*Abstract on p.* 60).

Maryland in the Beginning, by E. D. Neill.

This paper has been published by Cushings & Bailey, Baltimore, 1884. It is a review of some of the disputed questions concerning Maryland toleration and the character of Maryland founders.

January 11.—Dr. H. B. Adams in the chair.

Papers read:

The Virginia Parish, by Edward Ingle. (*Abstract on p.* 60).

Tariff Legislation, by Mr. Sheffield.

Review of Jevons' Method of Social Reform and Ward's Dynamic Sociology, by R. T. Ely. (*Published in the Christian Union, January* 24, 1884).

January 18.—Dr. H. B. Adams in the chair.

Papers read:

Von Holst's View of the Constitution of the United States, by E. P. Allinson.

January 24.—Dr. H. B. Adams in the chair.

Papers read:

The Political Writings of John Milton, by W. B. Scaife.

February 1.—Dr. H. B. Adams in the chair.

Papers read:

Origin of Institutional Government in Oregon, by C. H. Shinn.

This paper described the efforts made by the first American settlers in Oregon for the administration of justice and for the election of their own officers, in opposito the authority of the Hudson's Bay Company.

Development of Society and Government in California, by Josiah Royce.

February 8.—Dr. H. B. Adams in the chair.

Papers read:

Township Organization in the West, by E. M. Haines.

This was an informal lecture, explaining how township organization was introduced and how it is maintained in certain Western States. Mr. Haines codified township laws after the model of those of New York for Illinois, Michigan, and Minnesota, with digests of judicial decisions on local government, and blank forms for local officials arranged in connection with the statutory law. His lecture represented the life-work of an institutional pioneer.

Review of Kaufman's "Communism and Socialism," by R. T. Ely.

The Study of Calendars, by J. S. Fisher.

Bacon's Rebellion, by M. E. B. Roberts.

February 15.—Dr. H. B. Adams in the chair.

Indian Institutions, by J. W. Powell.

This was a lecture upon Indian sociology, showing the relation of kinship, family, clan, and tribe to the constitution of the Indian state and federation. Much emphasis was laid upon Indian customs, *e. g.*, marriage, the unwritten law of tribal councils, the election of chiefs, religious ceremonies, &c. The attention of the students was called to this inviting field of American institutional history.

February 22.—Dr. H. B. Adams in the chair.

Town and County Government, by Edward Channing.

This was an original monograph based upon a careful study of State laws, colonial archives, and English sources, touching the character of town councils, parish meetings, and county government, north and south. The essay was lately awarded the Topham prize of one hundred and fifty dollars at Harvard College for graduate work in history.

Mathematical Society.

January 16.—Dr. Story in the chair. Fifteen members present.

Papers read:

On the Mode of Representing Negative Quantity in the Logic of Relatives, by C. S. Peirce.

An Elementary Demonstration of Stirling's Theorem, by F. Franklin. (*Abstract on p.* 57).

On the Reduction of Quadratic Forms to Sums of Squares, by A. S. Hathaway. (*Abstract on p.* 57).

February 20.—Dr. Story in the chair. Ten members present.

Papers read:

A Symbolical Demonstration of Taylor's Theorem, by W. E. Story.

On a Form for the Residues of Composite Moduli, by A. S. Hathaway.

A Note on Developable Surfaces, by G. Bissing.

Metaphysical Club.

January 17.—Thirty-fifth regular meeting. Professor G. S. Morris in the chair. Nine members present.

Papers read:

Design and Chance, by C. S. Peirce.

Review of Dr. W. T. Harris's "Philosophy in Outline," by G. S. Morris.

February 12.—Thirty-sixth regular meeting. Dr. G. Stanley Hall in the chair. Seventeen members present.

Papers read:

The Nisus Formitivus in Sane and Insane minds, by G. Stanley Hall.

Review of a recent paper on the Origin of Death, by H. H. Donaldson.

Dr. G. Stanley Hall was elected President of the Club.

Archæological Society.

February 9.—Meeting for organization. President Gilman in the chair.

A form of constitution for the society was presented and adopted. (*See p.* 59).

Dr. A. Emerson was elected Recording Secretary, and Dr. A. L. Frothingham, Jr., Corresponding Secretary of the Society.

February 16.—First general meeting. Professor Gildersleeve in the chair. Forty-eight persons present.

Papers presented:

The study, past and present, of Christian Archæology, and the prospects of the Archæological Society, by A. L. Frothingham, Jr.

The study of Archæology and Art is of the greatest importance for history, and for a proper understanding of the religion, laws, and customs of past ages. Christian Art from the Catacombs to the Renaissance gives a true picture of Christian society. The Archæological Society intends to devote its attention to the Art of all nations and periods.

The Spread of the Study of Classical Archæology among civilized nations and the Work of this Society, by Alfred Emerson.

Since the first discoveries of antiques in Italy and Greece, but notably since Italy accomplished her national unity and Greece her independence, these countries have shown a strong interest in the preservation and study of their ancient monuments. Other countries, not the direct heirs of antiquity, have been equally assiduous. The expeditions sent out from England have made the British Museum the greatest extant repository of Greek art. France, to whom the foundations of our topographical knowledge of classic lands are due, was foremost also in establishing an exploring station and school of archæology in Athens, an example followed by Germany, America, and Great Britain. Germany is now the most active country. America bids fair to take a worthy place among these nations.

Address:

The Archæology of the Aboriginal Races of the United States, by Maj. J. W. Powell, Director of the U. S. Bureau of Ethnology.

Baltimore Naturalists' Field Club.

November 26.—Communications:

The Life History of the Bag-Worm (Thyridopteryx Ephemeræformis), by O. Lugger.

The Conditions which Influence Autumnal Leaf-Coloring, by B. W. Barton.

The Rocks between the Relay Station and Ellicott City, by E. B. Sanger.

January 16.—Communications:

A List of the Coleoptera found in the Neighborhood of Baltimore, by O. Lugger.

This list is the result of eight years' careful collecting by Mr. Lugger, and includes 72 families, 565 genera, and 2291 species.

The Collection of Parasitic Fungi, by W. Trelease.

The Latent Period in Buds, by H. H. Donaldson.

The Occurrence of Mineral Phosphate of Lime (Apatite) in Canada and its Use as a Fertilizer, by F. D. Adams, of the Canadian Geological Surgery.

The apatite is found in the Greenville gneisses of the Laurentian rocks, and occurs in both veins and beds. It is often met with in the form of crystals, some of which are of enormous dimensions, one which was measured being as much as 59 inches in circumference. The crude material is treated with sulphuric acid and converted into a soluble acid phosphate which is used as an artificial manure. The exportation from the port of Montreal for 1883 amounted to 19,000 tons.

The Minerals of the Jones Falls Gneiss Quarries, by W. S. Bayley.

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JOHNS HOPKINS UNIVERSITY CIRCULARS

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CALENDAR, 1883–84.

Tuesday, September 18.	**Current Academic Year Began.**
Monday, June 2.—Friday, June 6.	**Examinations for Matriculation.**
Friday, June 6.	**Term of Instruction Closes.**

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The usage of giving personal notification is not likely to be continued, and those therefore who have been accustomed to receiving such announcements, should hereafter consult the *Circulars*.

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A volume of CONTRIBUTIONS TO LOGIC by members of this University was issued in 1882, under the editorial direction of Mr. C. S. Peirce. Price $2.00. Little, Brown & Co., Boston, Publishers.

The University Circulars, Annual Report, and Annual Register will be sent by mail for one dollar per annum.

All communications in respect to these publications should be addressed to the "Publication Agency of the Johns Hopkins University," Baltimore, Maryland.

NOTES AND COMMUNICATIONS.

PHILOLOGY.

n the Final Sentence in Greek. By B. L. GILDER-

VE.

ract of a paper read before the University Philological Association, February 1,

s paper, in the form of a review of a treatise by Philipp Weber, has theme the development of the final sentence from Homer to Ionic The importance of such investigations as Weber's is shown, and the is expressed that certain points known to advanced students of grammar not been incorporated into our school text-books, such, for instance, as sentially poetic use of ὡς final in the classic period. Weber's results nsidered, corrected, supplemented, and commented on under the heads mer, Hesiod and the Homeric hymns, the Lyric poets, the Dramatic and Ionic prose writers. Among the subjects discussed are the con- ions of ἕως, the relations of hypotaxis and parataxis, the character of bjunctive, the shift of moods after past tenses of the indicative, the uction of verbs of fear. The character of the paper precludes an ade- presentation of the results in any concise form. In conclusion, the rer says: "The final sentence is now, for the first time, presented in ronological data. One may rebel against calling such work historical t, because we have really nothing more than a classification of occur- , and it is taken for granted throughout, and sometimes, as has been ted, without reason, that each author represents fully the thesaurus time. The personal equation is the great difficulty, and cannot be without a theory of the totality of syntactical phenomena in each . Still such chronological statistics, such records of the behavior of particles in certain authors, in certain departments, in certain periods, great importance. Without them, a history of Greek syntax is im- le. Without them, a scientific theory of syntactical style is impossible. out them, it is impossible to understand the course of later Greek, , after all, has an organic life, though that organic life is of such com- y that even when the mastery of classic syntax is attained, generations of ts will find work enough to do in exploring its processes and its diseases. s soon as the second part of Dr. Weber's treatise reaches us, another will be consecrated to the subject. Only, as has been said before, the final sentence does not present the same difficulties as the early forms, gh we shall have to encounter the troublesome question of the use of vith subjunctive and future.

conclusion, a serious gap must be noted in Weber's treatment of the entence—the omission of the relative form. While he admits that ὅπως lative, he is satisfied with giving Nägelsbach's six forms of the final e in Homer (p. 64), without any comment except that the ὅπως form ponding to ὅς κεν εἴποι is represented only in one passage (I 680), and ne form corresponding to ὅς κεν ἐρεῖ is doubtful (P 144). The study of ods of the relative ought genetically to have preceded the study of rm of the final sentence.

et another form of the final sentence, the future participle, and the tant outgrowth ὡς with the future participle, should not have been d. The latter construction is one of the most interesting in Greek, hould not be relegated altogether to the domain of *oratio obliqua*, *oratio obliqua* is the only ultimate explanation of it." (*Published in erican Journal of Philology, Vol. IV, No.* 4).

alogy and Uniformity. By M. W. EASTON, of the

ersity of Pennsylvania.

ract of a paper read at the meeting of the University Philological Association, 7, 1884].

results of much of the best recent work in etymology hold good only basis that the phonetic laws of any one dialect admit of no excep- A good statement of this position was given by Brugmann, some time Z vol. xxiv), together with certain recognized limitations; particu- he recognition of the possible co-existence, for a brief period of time, of younger and older forms. This limitation is not however observed in practice, and even Brugmann himself, in the article quoted, deems it necessary to resort to the hypothesis of borrowing, or of analogical formation, to explain the co-existence of a number of forms fairly to be classed under this head. This is particularly the case in the usual treatment of forms subject to ablaut, as πατέρος and πατρός, intervocalic sigma, etc.

The principle is new; for two dialects have been generally defined as characterized simply by a different aggregate of prevailing peculiarities, rather than by single particulars carried through the whole framework of each.

Two dialects differ from each other, not merely in their phonetic systems, but still more in the different organization of their meanings, including the different distribution of the functions of their systems of flexion. Such differences of meaning must however have had their start in the period before the divergence from the common mother tongue, and could not have originated had there been a precise, fixed correspondence between vocal symbol and thought. And, in fact, the results of the study of proethnic syntax have failed in detecting such a condition of primitive perfection; rather, we should contemplate, in language, as in other things, a gradual approach to precision and fixed subordination of function. Furthermore, changes of meaning can be conceived only as starting (each) from one individual and propagating themselves by a kind of wave action to the other members of the community. But there is no reason to suppose that, in all cases of alteration, the whole vocabulary of every individual will be affected. Probably this method of change in meaning will find a close parallel in changes of form.

The tendency to precision in etymologizing is a laudable, and has proved a fruitful, tendency, but should not assume absolute uniformity in phonetic change. The recorded forms of the Indo-European languages directly oppose such an assumption. Exceptions are indeed explained away by assuming mixture of dialects, and still more frequently by appealing to analogy. No doubt the action of analogy is quite competent to remould a language to any extent, perhaps no word in the whole united vocabulary of the Indo-European tongues has altogether escaped it. But the appeal to analogy is so largely subjective, and so difficult to subject to fixed law, that it can be resorted to to this extent only, when exceptions to well established, probable law are to be disposed of, and even then is often merely of the nature of *hypothesis*. Absolute uniformity of phonetic processes, *e. g.*, that πατέρος and πατρός could not have existed side by side, the former being a remnant of a primitive formation, is not such a well-established law; nor is it a probable law.

We may note here that, if analogy is competent to produce in the later language, and to maintain in use, double forms, it is competent to have maintained them from the first, side by side. But the advocates of uniformity reason as though analogy were, as a disturbing force, quiescent during certain periods of the history of a speech.

Now no sufficient explanation of the mechanism, or of a mechanism, by which uniformity throughout a community, or even in the whole vocabulary of single individuals has ever been brought forward. Such a condition of things could be produced only in virtue of a profound alteration of the physiological alphabet, perhaps affecting the whole community at once. This has been clearly seen and clearly defined by Brugmann. But this required condition is mysterious and incomprehensible. The chief altering force known and understood, is the tendency to economize muscular action, and this is intermittent; as a very brief examination of the frequent variation in the pronunciation of our own language soon shows.

Uniformity throughout the community, in any degree, is attained, as is well known, by imitation, the new forms spreading from one person to another, and, even here, mainly due to economy, which acts in general to drive out one of two or more synonymous discordant forms. But this process is never complete; that is, the organization of a language is loose. The process is well illustrated by the history of the diffusion of new forms due to analogy; these two are diffused in the same manner, and show, as is universally confessed, the same incompleteness of diffusion. The action of economy is never thoroughgoing. Rhetorical needs, also, check it in modern languages, to a very great extent.

Double forms, due to analogy, are indeed, for various reasons, so much more numerous than those due to ordinary phonetic divergence, as to convey the impression of existing in virtue of some special exceptional law.

The principle referring the inception of phonetic change to alterations in the physiological alphabet, separates too widely such cases as might possibly fall under it, namely, where sounds entirely disappear from a language, or suffer, in all words, some alteration in mouth position, from all the other, (much more numerous) phonetic differences between cognate dialects, *e. g.*, the changes under Grimm's Law, where a proethnic *t* becomes *d*, in certain English words, although *t* still remains in the language. Compare also the laws of finals.

Nor does the simple theory of economy of muscular action fully explain such cases, as is very well known. Perhaps most purely phonetic change may also be referred to the analogy of other words in the language, already containing the new combinations of sounds; thus the inorganic *ϑ* in *ἀνϑρωπος* may be simply the result of the reminiscence of organic-*νϑρ*-elsewhere. From this point of view, the inception of new phonetic law may seem a little less mysterious, and additional theoretical reasons found, in virtue of which we may assume it to be probable that complete uniformity will not be attained; all analogy action is confessedly irregular.

If, however, it be once admitted that a language may present inconsistent phonetic phenomena, it follows that the reconstruction of mother tongues, and particularly of intermediate mother tongues (general Germanic, general Low German, &c.) is a very uncertain process, because a phonetic law of very limited range may extend itself and become the prevailing law in a group of derived cognate tongues. And, conversely, the deduction of a special form from one existing or hypothetical parent form, with irregularities attributable only to later borrowing, analogy, etc. is correspondingly liable to error. This is true of the relation of the Indo-European family of languages to the primitive tongue.

On the Probability of the Existence of Phonetic Law.

By M. Bloomfield.

[Abstract of a paper read at a meeting of the University Philological Association, March 7, 1884].

The belief in the existence of inviolable phonetic law which according to the extremest view acts like a law of nature cannot at present be freed from the charge of dogmatism (cf. Whitney, Proc. Am. Phil. Ass., 1882, p. xviii; Fr. Müller, Techmer's Zeitschrift für Sprachwissenschaft, I, p. 213). Phonetic action, whatever its cause may be, is crossed by analogy, another powerful factor in linguistic change, which certainly does not act with sufficient regularity to enable us to point out its exact extent, to eliminate it from our count, and to leave a clean balance of phonetic action. It is only by a sense of linguistic taste or tact, qualities confessedly subjective, that the doings of analogy can be scanned; there is nothing inductive about this. Every accepted explanation through analogy is accepted only in so far as the prevailing opinion of the best grammarians holds that the deviation from the path of phonetic law has been thus and thus and not some other way. Moreover the words 'inviolable' or 'infallible' in matters of grammar are always to be deprecated, because the conscious will of the language user certainly stands above phonetic facts. We ought rather to speak of the regularity of phonetic courses, which are never left without some positive causes for deviation.

Though the doctrine of phonetic law even in this modified form is a dogma which will never be proved inductively, it can nevertheless be invested with a satisfactory degree of probability. The following are the arguments:

1. No other known theory succeeds in any way in satisfactorily explaining the origin of regular phonetic change on a large scale. There is no point in Whitney's discussions of language which provides satisfactorily for this phenomenon. In two passages of his 'Language and the study of Language' (pp. 95 and 152) he confesses himself unable to account clearly for the most prominent phonetic peculiarities of individual languages, and whatever suggestion these passages do contain is in accord with the theory of phonetic law. Prof. Easton's suggestion (*see above*) that 'perhaps most purely phonetic change may also be referred to the analogy of other words in the language, already containing the new combinations of sounds' ignores the fact that certain changes and developments of sounds must be phonetic and not analogical because they are of frequent or universal occurrence in widely different languages; furthermore, the regularity of certain phonetic facts (as *e. g.* Grimm's law when supplemented by Verner's) is in no way disposed of by this assumption. Neither are we likely to be satisfied by Frdr. Müller's parallel between phonetic law and fashion (loc. cit.)

2. Our judgment as to the intrinsic probability of the theory depends upon the extent and the character of the ground which it would cover in the case of its general acceptance. If it be framed to cover a few cases of small scope it falls from its own weakness. If on the other hand it accounts for just those parts of the language-body and language-history which are most scrutable and exposed, and if these form a sufficiently respectable share of the entire mass of the language facts this hypothesis like all others thereby itself becomes a probability. Two facts which show the latter to be true must be borne in mind here. First, there is no language which can be studied historically or comparatively that does not exhibit phonetic facts of sufficiently wide scope to allow us to apply to them the term phonetic law. Secondly, the more incisive the study of any group of languages becomes, the larger grows the number of phonetic laws. On the other hand, it would be impossible to exhibit any language where the phonetic changes either within its own special history or when compared with its kin are exclusively sporadic or arbitrary. Yet nothing would be more natural than just this state of things, providing that nothing but the semi-conscious whim of the individual, aided by his linguistic pet-vice of laziness, originally lay at the bottom of every phonetic change.

3. In the manner in which the principle of phonetic law has accomplished work lies the strongest proof of its reality and its surest hold upon linguistic science. It is obviously beyond the scope of an abstract to point this out, as it would involve a short history of Indo-European, and to some extent Shemitic, grammar within the last few years. It is not too much to say that if the doctrine of the inviolableness of phonetic law should ultimately turn out to be false that this fact would not detract very much from its methodological value; there it has approved itself by its fruits.

The Nahuatl-Spanish Dialect of Nicaragua.

By A. M. Elliott.

[Abstract of a paper read at a meeting of the University Philological Association, March 7, 1884].

The text on which this investigation is based constitutes No. III in the series of Dr. D. G. Brinton's "Library of Aboriginal American Literature" and is published under the title of "The Güegüence, a Comedy Ballet in the Nahuatl-Spanish Dialect of Nicaragua." It is printed from a collation of two MSS. made by Dr. Berendt in 1874, no part of which has ever before been translated. Both the age and authorship are unknown. With reference to the former the able editor thinks we may assign the early portion of the eighteenth century as the latest date for its composition, and there is some evidence that a more remote period is not improbable.

The language represents a *mischdialekt* composed of Nahuatl and Spanish elements, the latter bearing the stamp of the home idiom when it was brought into contact with the aboriginal tongue at the beginning of the sixteenth century, through the conquest of Mexico by the Spaniards. The formal conquest of Nicaragua took place in 1522, when it was attached to the Captain Generalcy (*Audiencia*) of Guatamala, under which rule it remained till the outbreak of the revolution in 1821, thus making three hundred years of steady, uninterrupted Spanish dominion. The Europeans found in Central America the same extraordinary idiom, the Aztec, Nahuatl, or Mexican, which they had learned to know on the vast plain of Anáhuac. This was a language not only of wonderful copiousness and flexibility, but also an extremely polysynthetic speech in which the process of agglutination has the greatest sweep. The linguistic tendencies were thus directly opposed here to the strong analytic development of the Neo-Latin language with which the native idiom was brought into contact by the conquest of Mexico.

In sifting the material of this compound product, the resultant of a mixture of two contrary lines of language growth, we must take as our basis the classical Spanish of the time of Cervantes, born just a quarter of a century after the occupation of Nicaragua, with its now obsolete grammar forms and antiquated constructions, and to this add the varying dialect influences which must have been brought to bear on the new product by the common speech of the Spanish soldiers.

If we begin with the vowel system, we find the most common differences that separate the Nahuatl from the classic Spanish and bind it with the old and dialect form of the same, to be: *e*= *i*, *o*= *e*, *o*= *a*. For example, *Velancicos* (*Sp. villancicos*), *seno*, (*Sp. sin*) where the *i*, both tonic and atonic,

ɔen strengthened and raised a point in the scale of phonic production.
is a special trait of the Old and Folk's language in Spain. The same
ncy to raise the weak vowels we find illustrated in the Old Latin by
acillation between *e* and *i* in such forms as *tempestatebus*, *mereto* com-
with the classic *tempestatibus*, *merito*. In the Spanish Folk speech it
ıe *e*-form that was kept, and especially at this period of the language
ıic *i* was constantly represented by *e*, as in *Cecilia* (for *Cicilia*), *dejiste*
ijiste), etc. Again, the more common raising of the vowel power
to *a* is in accordance with the usual Spanish dialect influence *e. g.*
Castalar (for *Emilio Castelar*), *Ajercito* (for *Ejercito*), used by the
in Castile, and is especially marked in the moulding of Nahuatl forms
t the requirements of Spanish flexion or to satisfy the demands of
sh euphony.

eno = O. Sp. *sines*, *senes*, we have *e* = *o* just as in the modern *obispo*
opus) or the Old Spanish *romanecer* (Mod. Sp. *remanecer*).

the consonantal system we find, for the most part, certain classes only
d, namely, the gutturals and sibilants. In the first title itself of the
we have the aspirated Nahuatl *h* of *huehue*, "old man," passing
ırly into the medial guttural, similar to the transference of the Gothic
ı Teutonic to certain parts of the Romance soil. The lowering of the
u to *ü*, together with this gutturalization of initial *h*, is a mode of
ıg with the initial *hu* that is found in various districts of the Spanish
sula, but it is especially the Asturian who always says *güertu*, *güeso*
stilian *huerto*, *hueso*, etc.

he Cuban dialect there is no difference in the pronunciation of the
ic signs *c*, *z*, *s*, all of them being the simple sibilant *s*. So, too, *x* and
rchange in the Nahuatl-Spanish *e. g. Silguerio* (for Span. *Xilguero*).
x at the time of the conquest of Mexico was = English *sh* or Arabic
ش, and hence its origin as the notation of an unknown quantity.
c شىء (šai) "thing" (= Italian *Cosa*), used for this purpose, was
d to simple ش = *x*.*

ts morphology the Nahuatl-Spanish separates itself more clearly from
odern language than in its phonology. The Mexican has had little
ıce here so far as the individual word is concerned. In the nomen-
old Spanish forms with special dialect influence are the chief factors
onstitute the difference between the new mixture and the Castilian of
.

it is especially in the verb that we note the most striking charac-
cs both of a stage of language older than the present Castilian and of
tensive play of dialect power.

most interesting peculiarity of the verb formation is seen in the future
which is built up almost exclusively in the regular periphrastic man-
the Romance languages, save that the component elements are not
d together, that is, the auxiliary is kept distinct from the infinitive
relational *de*, so that we have *ha de hablar*, *ha de ser*, etc. It is thus
ıve the special idiomatic futures that represent "duty, intention,
ı, possible possession," passing over sometimes into a state of verbal
which does not bear these special significations. There are only a
few infinitival types in this whole play where the parts are bound
ıer into a single whole, and these simply serve to denote indefinite
conditions without any limitations whatever.

the new word-building of this dialect we find the same modes of
lure which come up in the adaptation of Teutonic roots to Romance
But with all the changes of both phonology and morphology we do
ıve the dialect character of the "Güegüence" so well established as in
ntax. It is here especially that we find the extended influence in
n cases of the native idiom and again witness more directly than any
else the strong drift towards a strictly agglutinated form of language
ich all flexion has disappeared and where nothing but the context
us in trying to discover the thought of the writer.

s paper will be found in full in the forthcoming number of the *Ameri-*
urnal of Philology.

Paul de Lagarde: Woher stammt das *x* der mathemateker? Gött. gel. Anz., 1882, Prof. Paul Haupt was so kind as to call my attention specially to this article.

On the Angelology of Hermas. By J. Rendel Harris.

There is a passage in the Shepherd of Hermas, Vis. iv, 2, 4, which has occasioned a great deal of perplexity to the commentators. Hermas is met by a fierce beast with a parti-colored head, which beast symbolizes an impending persecution or tribulation, and makes as though it would devour him. But the Lord sends his angel who is over the wild beasts, whose name is Thegri, and shuts the mouth of the creature, that it may not hurt him. *θεγρί* according to Gebhardt and Harnack is 'nomen inauditum'; it appears in the Vulgate Latin as *Hegrin*, and in the Palatine version as *Tegri*. The Ethiopic translation has Têgêri. Jerome seems to have read *Tyri* since in his comments on Habac., 1, 14, we have "ex quo liber ille apocryphus stultitiæ condemnandus est, in quo scriptum est quemdam angelum nomine Tyri præesse reptilibus." Much ingenuity has been expended over the origin of the word and in particular the following is the solution of Franciscus Delitzsch, as given in Gebhardt and Harnack's edition: "Si sumi possit, Hermam nomen angeli illius ex angelologia Iudaica hausisse, quæ angelos maris, pluviæ, grandinis, etc., finxit iisque nomina commentitia indidit, *θεγρί* idem est quod תִּגְרִי(תִּגְרִי) *instimulator*, h. e. angelus, qui bestias (contra homines) instimulat atque, si velit, etiam domat (Taggar = dissidium, discordia; cum î = Tigrî, quod bene transcripsit H.: *ϑεγρί*), etc."

I assent to the Hebrew origin of the name, but am unwilling to explain a 'nomen inauditum' by a 'nomen vix auditum.' A more simple solution suggests itself; if for *θ* we write *σ*, according to the confusion common in uncial script, we have *Σεγρί* for the name of the angel; which immediately suggests the root סָגַר, to close. The angel is the one that *closes* or *shuts*. This is immediately confirmed by the language of Hermas, *ὁ κύριος ἀπέστειλεν τὸν ἄγγελον αὐτοῦ τὸν ἐπὶ τῶν θηρίων ὄντα, οὗ τὸ ὄνομά ἐστιν θεγρί, καὶ ἐνέφραξεν τὸ στόμα αὐτοῦ ἵνα μή σε λυμάνῃ.*

If any doubt remained as to the correctness of this solution it would be swept away by reading the passage in Hermas side by side with the LXX of Dan., vi, 23: *ὁ θεός μου ἀπέστειλεν τὸν ἄγγελον αὐτοῦ καὶ ἐνέφραξεν* (וּסְגַר) *τὰ στόματα τῶν λεόντων καὶ οὐκ ἐλυμήναντό με.*

The curious parallelism of the language employed in the two passages is decisive as to the etymology, and further we may be sure that the language of Hermas is an indirect quotation from the book of Daniel.

The result arrived at is an important one in many respects, and has a possible bearing upon the genealogy of the MSS. and versions of Hermas; so far as we are concerned we may simply say that those copies and versions which read *θεγρί* or any variation of the same bear conclusive marks of a Greek original. It might seem unnecessary to make such a remark, but the fact is that grave suspicions have been thrown out in some quarters as to the character of the original text of Hermas. Upon further consideration I am inclined indeed to conclude that all the versions came from an original copy which read *θεγρί*, for even the Vulgate Latin which has *Hegrin* seems to have arrived at it by dropping the reduplicated T in the words NOMEN ESTTHEGRI. There is however, another way in which the Latin variant might be explained; for, as Dr. Haupt points out to me, we have a similar transformation in the Hebrew סְפַרְוַיִם (2 Kings, xviii, 34), which appears in Berosus as *Σίσπαρα*, in Ptolemy v. 18 *Σίπφαρα*, but in Pliny vi. 123 as *Hipparenum*.

Historical sketch of Syriac Literature and Culture.

By A. L. Frothingham, Jr.

[Abstract of two papers read before the Society for the study of Shemitic Philology. January 13 and February 28].

The Syriac language is of especial importance from the position which it took at the time of two great religious revolutions: the conversion of the East to Christianity and the rise of Mohammedanism. In the first case it became the sacred language of the converted Eastern peoples, and in the second it was the means of communicating Greek culture to the Arabs.

During the early period of Christianity Syriac came into general use among the converts of Armenia, Persia, Arabia, and was even propagated by colonies to Hindustan and China. This universal use was facilitated by the fact that versions into Syriac of nearly all the works of the Greek Fathers were made at early dates: in fact many of their important writings have been preserved only in Syriac, *e. g.* Melito, Ambrose, Hippolytus, Theophania and Martyrs of Palestine of Eusebius, Festal Letters of Athanasius, &c.

The earliest work of importance is the version of the Bible called *Peshitta*, probably made at the beginning of the second century. Bardesanes and his son Harmonius, and Tatian the Assyrian are important writers of this century, and in the following, Mani wrote mostly in Syriac, as we know from many Eastern and Western authorities.

The fourth century was the golden age of the literature, when the language obtained a settled standard of taste, especially under the influence of the numerous writings of Ephraem.

An impulse to literature and learning was given by the Nestorian controversy in the fifth century which heresy was so vigorously supported by the famous "School of the Persians" at Edessa, that it was closed by orders of the Emperor Zeno (489) and its professors transferred their *penates* to Nisibis and Seleucia in the Persian Empire.

Connected with Nestorianism was the influence that Greek learning began to acquire over Syria, which led to the close study of the best writings of antiquity, favored by the leaders of the schools or universities. These universities had a great influence, not yet sufficiently appreciated, on the tendencies of the age; they were numerous and existed not only in the cities but attached to the principal monasteries. Their privileges were great and they were generally quite independent. The most noted were those of Edessa, of Nisibis for theology, and of Gandisapur for medicine: the great majority provided for a general liberal education. It is recorded that the students at Nisibis under Hanan (sixth century) numbered fully 800.

The sixth century was a period of great literary activity: the most prominent writers were James of Sarug and Philoxenus of Hierapolis, both belonging to the Monophysite sect. Now, for the first time, was attention given to the writing of history. Material was at hand in the precious archives of Edessa which existed from the beginning of the Christian era: some use was made of the documents there preserved by the anonymous Chronicle of Edessa (c. 540). The histories of Zacharias Rhetor and John of Asia are of value, especially for Eastern history.

An abrupt change was brought about by the Mohammedan invasion, which, although it by no means put an end to the literary activity of Syria, yet strongly influenced its development by the gradual extinction of the Syriac language among the people. The influence of Arabic began to be felt almost immediately after the conquest, although, of course, first in administrative and commercial centres.

In order to guarantee the purity of Syriac, the school of purists founded by Jacob of Edessa (710) found it necessary to establish a standard of taste and to express by written signs the mechanism of vowel pronunciation, until then left unexpressed. This movement was accompanied by an increase of Greek influence; and the combination of this with the gradual inroads of Arabic soon marred the idiomatic beauties of the language.

The Syrians had already become divided into two great camps, the Nestorian and the Monophysite or Jacobite, and each had its great centres of education and special literature. The influence of the Nestorians was greater, especially with the Arabs.

At this time many schools are founded by Syrians at Bagdad, and to these the Arabs flocked to learn the wisdom of the Greeks. From the eighth to the tenth century the Christian Syrians are the acknowledged masters of the Arabs: many like Honain, Isaac, John bar Mesue, &c., obtain fame by translating the Greek standard works on philosophy, medicine, mathematics, astronomy, geography, mechanics, &c. The Khalifs of the dynasty of the Abbassidae gloried in their munificent patronage of Syrian learning: the royal physician was invariably a Syrian, also the royal treasurer and other officers, and even governors of cities and provinces.

While Syriac literature declined in taste it acquired more scientific tendencies. Philosophy became one of the principal studies: that of Aristotle was mainly followed and many commentaries were made of his writings. Grammar and lexicography also began to receive considerable attention, and at first Greek and later Arabic models were followed. Historical studies also assumed more importance: Jacob of Edessa, Dionysius of Tellmaḥre (c. 775), Thomas of Marga (IX), Michael the Great (1090), and Gregory Bar'ebraia (XIII), form a long chain of writers on history who are recognized as of standard value.

Since the tenth century Syriac learning had fallen very low: in the thirteenth the Patriarch Bar'ebraia made an attempt to restore life to it, but even his scholarly genius, though embracing all branches of learning, did not succeed.

T. L. Beddoes, a Survival in Style. By Henry Wood.

[Abstract of a paper read at a meeting of the University Philological Association, November 2, 1883].

The man and his writings are so nearly forgotten, and copies of his works so scarce, that the article gives a few particulars of his life as an introduction. These serve also to explain in part the fact that Beddoes' writings, in spite of the laudatory reviews which even the earliest of them forced from every critic who took the trouble to read them, never really impressed his own age, and have been regarded as lying outside the range of English dramatic literature, the productions of "a strayed singer." The article is not further concerned with the faultiness of this traditional literary estimate of Beddoes, which sufficiently appears in the course of the investigation. Its object is to show that the style of Beddoes' writings (aside from certain peculiarities) is in the national and historical sense thoroughly English: a remarkable example of the survival of the main characteristics of such a style, in undiminished vigor, in the nineteenth century. For convenience of comparison, the Anglo-Saxon epic poetry and Shakspeare are taken as representing the two most important periods, and the similarity of Beddoes' style is shown in detail. The question of constructive power, or of the general canons of style is not entered upon, the comparison being mainly one of figures of speech. It is not assumed that Beddoes completely represents his own age. But on the other hand, his own letters and the character of his works prove him to be no imitator nor Shakspeare reviver, his vocabulary and constructions are thoroughly modern, and he profoundly admires three modern poets, Shelley, Wordsworth, and Keats. The comparison of Beddoes' style, or of any strong English style, with the intensely subjective Anglo-Saxon epic-lyric style has its difficulties, but it is plain that the prime characteristics of the A. S. metaphor recur in a marked degree in Shakspeare's and Beddoes' use of that figure, while the two latter agree surprisingly in their handling of the simile, which the A. S. scarcely used. An extended list of epithets, or kennings, is given from Beddoes, and with them are compared similar ones from Shakspeare, the A. S. Genesis, Exodus, Béowulf, and from Old Norse. A very close coincidence is revealed, and in many instances both Shakspeare and Beddoes are found to be as Anglo-Saxon as are the Anglo-Saxons themselves, in regard to the nature and scope of their epithets.

The article of which the foregoing is an abstract is published in full in the *American Journal of Philology*, Vol. 4, No. 16.

The concluding part, treating of fully expressed metaphors, similes, etc., will appear in Vol. 5, No. 18.

MATHEMATICS.

A Note on Partitions. By G. S. Ely.

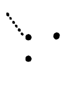
[Abstract of a paper read at a meeting of the University Mathematical Society, March 19, 1884].

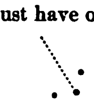
From the partitions of any number, n, can be formed the partitions of $n+1$, by the addition of a unit to each of the parts of each of the partitions of n, which is less than the previous part. Thus, for example, from the partition of 10, . . . 5, 2, 2, 1, can be generated the following partitions of 11—

6, 2, 2, 1; 5, 3, 2, 1; 5, 2, 2, 2; 5, 2, 2, 1, 1.

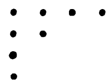
Then it is evident that any partition of n, will, in this way, generate as many partitions of $n+1$, as there are parts of different values in the given partition of n, plus one: and that any given partition of $n+1$, will be generated from the partitions of n, as many times as there are parts of different values in the given partition of $n+1$. It is furthermore evident that if two partitions of n are conjugate, the partitions of $n+1$, which are generated from them, will be conjugate.

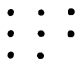
If the total number of partitions of n be of parity opposite to the total number of partitions of $n+1$, then there has been a gain in the number of self-conjugate partitions of $n+1$, over that of n, provided that n is greater than one. Passing from 1 to 2 there is evidently a loss in the number of s. c. p. (= self-conjugate partitions). But in any other case than $n=1$, let us consider a s. c. p. of n. The point at the end of the principal diagonal and the points immediately adjacent to it must have one of the two forms:



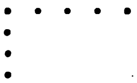


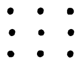
where the dotted line is the principal diagonal. In the first case we can place an extra point at the end of the diagonal and thus generate a s. c. p. of $n+1$. In the second case we may place an extra point at the end of the first line and remove the point from the end of the diagonal and place it at the bottom of the first column: and thus generate a s. c. p. of $n+1$. Thus it is evident that every s. c. p. of n may be used to generate a s. c. p. of $n+1$, and from the manner of generation it is evident that different s. c. p.'s of n will generate different s. c. p.'s of $n+1$. Thus the two s. c. p.'s of 8 are





which generate the s. c. p.'s of 9,





Therefore the number of s. c. p.'s of $n+1$ cannot be less than the number of s. c. p.'s of n ($n>1$). Therefore when the parity of the whole number of partitions changes in passing from n to $n+1$, there is a gain in the number of s. c. p.'s ($n>1$). And in such a case the gain must be a gain of an odd number of s. c. p.'s. It is of course possible that there should be a gain in the number of s. c. p.'s in passing from n to $n+1$ where the parity does not change, but such a gain must be a gain of an even number of s. c. p.'s. For example, in passing from 23 to 24 the parity does not change, but there is a gain of two s. c. p.'s, *i. e.*, from 9 to 11.

If we examine Euler's table we see that the parity of the whole number of partitions changes in passing from 2 to 3, from 7 to 8, from 11 to 12, from 14 to 15, from 16 to 17, from 18 to 19, from 19 to 20, etc. Hence as 2 has no s. c. p., the numbers from 3 to 7 inclusive must have at least one s. c. p. each; from 8 to 11 at least two each; from 12 to 14 at least three each; 15 and 16 at least four each; 17 and 18 at least five each; 19 at least six and 20 at least seven. Constructing the s. c. p.'s by the method which Dr. Durfee has given we find that 20 has just seven s. c. p.'s. Hence the numbers from 2 to 20 have just the number of s. c. p.'s which has been given.

Unicursal Curves of Degree $n+1$ in n-flat Space.

By G. BISSING.

[Abstract of a paper read at a meeting of the University Mathematical Society, March 19, 1884].

The relation connecting the parameters of the points of intersection of a plane unicursal cubic and a right line is known. Taking then, by analogy, the unicursal curve of degree $n+1$ in n-flat space,

$$\theta x_j = a_{j,1}u^{n+1} + a_{j,2}u^{n+2} + \dots a_{j,n+2} \qquad (j = 1, 2 \dots n+1),$$

we wish to find the k conditions that $n+2-k$ of its points, say $u_1, u_2 \dots u_{n+2-k}$, should lie in an $n-k$ flat; $(k = 1, 2 \dots n)$.

I define $A_1, A_2 \dots A_{n+2}$ as the determinants of order $n+1$ obtained by omitting respectively the first, second ... $n+2$d column from the matrix of the coefficient of the above system of $n+1$ equations, and $(u_j)_l$ as the sums of the homogeneous products of $u_1, u_2 \dots u_j \dots u_l$ taken j at a time. The k conditions are then

$$\begin{aligned}
&A_1 + A_2(u_1)_{n+2-k} + A_3(u_2)_{n+2-k} + \dots A_{n+3-k}(u_{n+2-k})_{n+2-k} = 0,\\
&A_2 + A_3(u_1)_{n+2-k} + A_4(u_2)_{n+2-k} + \dots A_{n+4-k}(u_{n+2-k})_{n+2-k} = 0,\\
&\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
&A_k + A_{k+1}(u_1)_{n+2-k} + \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad A_{n+2}(u_{n+2-k})_{n+2-k} = 0.
\end{aligned}$$

To prove this for $k=1$, take as the equation of the $n-1$ flat,

$$l_1x_1 + l_2x_2 + \dots l_{n+1}x_{n+1} = 0.$$

Substituting herein for the x's their values in terms of u, we get

$$u_{n+1}\sum_1^{n+1} l_j a_{j,1} + u_n \sum_1^{n+1} l_j a_{j,2} + \dots \sum_1^{n+1} l_j a_{j,n+2} = 0.$$

From this we obtain at once by definition of $(a_j)_l$,

$$\begin{aligned}
(u_1)_{n+1} &= -\frac{\Sigma l_j a_{j,2}}{\Sigma l_j a_{j,1}},\\
(u_2)_{n+1} &= \frac{\Sigma l_j a_{j,3}}{\Sigma l_j a_{j,1}},\\
&\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
(u_{n+1})_{n+1} &= (-)^{n+1}\frac{\Sigma l_j a_{j,n+2}}{\Sigma l_j a_{j,1}}.
\end{aligned}$$

Now it is evident that we shall obtain the desired relation between the u's by eliminating the l's from this system of equations. The equations being linear in the l's the eliminant is a determinant which, upon interchanging rows and columns, may be written

$$\left|\begin{array}{c}
a_{12} + a_{11}(u_1) \quad a_{31} - a_{11}(u_2) \dots a_{1,n+2} \pm a_{11}(u_{n+1})\\
a_{22} + a_{21}(u_1) \quad a_{23} - a_{21}(u_2) \dots a_{2,n+2} \pm a_{21}(u_{n+1})\\
a_{32} + a_{31}(u_1) \quad a_{33} - a_{31}(u_2) \dots a_{3,n+2} \pm a_{31}(u_{n+1})\\
\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot\\
(n+1) \text{ rows}
\end{array}\right| = 0,$$

where the bracketed u's are to have the suffix $n+1$ attached. This determinant, however, evidently reduces to

$$A_1 + A_2(u_1)_{n+1} + A_3(u_2)_{n+1} + \dots A_{n+2}(u_{n+1})_{n+1} = 0,$$

which is then the relation connecting the parameters of any $n+1$ points which lie in an $n-1$ flat.

Solving this equation for u_{n+1} we get

$$\begin{aligned}
-[A_2 + A_3(u_1)_n + A_4(u_2)_n + \dots A_{n+2}(u_n)_n]u_{n+1} &=\\
A_1 + A_2(u_1)_n + A_3(u_2)_n + \dots A_{n+1}(u_n)_n&.
\end{aligned}$$

Now, in general, n points determine an $n-1$ flat, and therefore for a definite system of values of $u_1, u_2 \dots u_n$ we get a definite value of u_{n+1}. If, however, these n points lie in an $n-1$ flat, there are an infinity of $n-1$ flats passing through them which therefore cut the curve in an infinity of points, and we can have no definite value of u_{n+1}. The two conditions that the n points $u_1, u_2 \dots u_n$ should lie in an $n-1$ flat are, therefore,

$$\begin{aligned}
A_1 + A_2(u_1)_n + \dots A_{n+1}(u_n)_n &= 0,\\
A_2 + A_3(u_1)_n + \dots A_{n+2}(u_n)_n &= 0.
\end{aligned}$$

And so on in general.

I add that Mr. E. Weyr has obtained these relations for the case $n=3$.

HISTORY.

Additional Notes on Icaria.

By ALBERT SHAW.

[Abstract of a paper read before the Seminary of Historical and Political Science, March 21, 1884].

In the *University Circular* for November, 1883, the writer gave an abstract of a paper on the career of Étienne Cabet, the French communist, and the founding of the Icarian Community, the history of which was traced from its disastrous experience in Texas and its brief residence in New Orleans, through the period of its successful existence at Nauvoo, Illinois, to the quarrel and division of the community, and the unhappy death of Cabet in St. Louis in 1856. The present paper continues the story of Icaria from 1856 to 1884. The minority, 180 in number, who had followed Cabet from Nauvoo to St. Louis only a week before their leader's death, were left in sorry straits; but they resolved unanimously to persevere in their enterprise and remain together. They purchased an estate called Cheltenham, in the suburbs of the city, and were known as the "Cheltenham Community." Their men were tailors and shoemakers, and worked in the city. The Community was weakened by a disagreement between those wishing a democratic and those wishing a dictatorial government. The civil war gave the finishing blow, and Cheltenham ceased to be.

The majority, who had remained at Nauvoo, were left with embarrassed finances; and the panic of 1857 forced them to make an assignment of their property. They retained, however, a tract of land in Adams county, southwestern Iowa, whither they removed, depleted in numbers and crushed by debt. Up to 1876 their story is a monotonous record of hardship, perseverance, and gradual recuperation. In 1877 they were on a sound material basis and their prospects seemed flattering in every way. Just at this time, however, the Community was entering upon the crisis inevitably involved in transferring the enterprise to the hands of a second generation. There arose two parties, the old party, or conservatives, and the young, or liberal party. The latter advocated more vigorous propaganda and a freer policy in the matter of admissions. The difference had been accentuated by the arrival of a number of French Internationalists, most of whom had been active participants in the Paris Commune of 1871 and all but one of whom joined the young party. Amicable adjustment failing, the young party carried the strife into the courts and succeeded in obtaining a nullification of the charter of incorporation, on technical grounds. The estate (of nearly 2,000 acres) was divided between the parties and they re-organized into two autonomous communes, the young party securing the name "Icarian Community" and the old party adopting the title "New Icarian Community." The paper proceeded to describe the industrial organization and social life of the two communities as seen by the writer on visits paid in May and October, 1883. The community of the old people is small in numbers and does not give great promise of growth.

Several members left the young party about 1880 and went to Cloverdale, Sonoma Co., California (near San Francisco), where they purchased a fruit farm and arranged for the development of a large communistic society on Icarian principles. The remaining members of the Iowa party of the young people have now formed a contract of union with the California Icarians, and are about moving thither. This new colony bears the name "Icaria-Speranza," the latter name being added in honor of the distinguished socialist and philosopher Pierre Leroux, who wrote a sketch of an ideal society which he entitled "Speranza," and whose nephews formed the nucleus of the California colony. Fruit-growing seems a business peculiarly well adapted to a communistic society of Gallic origin, and the future history of "Icaria-Speranza" will be awaited with interest. The remaining portion of the paper contained a series of personal sketches of various Icarians of the past and present, many of whom have been remarkable characters and have had curious and noteworthy careers. Among those described are: A. A. Marchand, J. B. Gérard, A. Picquenard, P. J. Favard, M. Mercadier, Eugene Mourot, Émile Fugier, E. F. Bettanier, Antoine von Gauvain, A. Souva, Émile Peron, J. Laforgue, A. Tanguy, S. Dereure, Charles Levy, Jules Leroux (pére), Pierre Leroux (fils) and Jules Leroux (fils), Adam Dehay, and Émile Bée.

The Beginnings of Connecticut. By Charles H. Levermore.

[Abstract of a paper presented to the Historical and Political Science Association, March 28, 1884].

I.—*The Dutch and the Pilgrims.* In the valley of the Connecticut river Dutchmen and Englishmen first wrestled earnestly together for the possession of the New World. The colony of Plymouth became, in the main, a trading corporation, reaching out one hand to the Kennebec and the other to the Connecticut. Still more exclusively upon an economic basis was the settlement at Manhattan. Dutch traders blazed the way where Englishmen afterwards followed. After Adrian Block's interesting voyage of exploration in his American-built yacht, "The Unrest," there are accumulating evidences of the presence of Dutch traders and settlers upon the "Versch," or Connecticut river. Of these evidences New England historians have either been ignorant or contemptuous. Out of the invaluable treasures of the Holland Documents proofs are drawn of a Dutch settlement upon the river so early as 1623. The deposition of the Walloon, Catelina Trico, in 1688 concerning the fort at "Harford river" is especially important. When Isaac De Rasier headed an embassy from Fort Amsterdam to Plymouth in 1627, and smote upon the ears of the quiet villagers with "a great noyse of trumpeters," the English obtained their first knowledge of the Connecticut valley, and were invited to share it with the Dutch. The English were also urged to visit the river by Indians, one of whom "had lived in England with Sir Walter Raleigh." In the correspondence between the two English colonies, and with the agents of the Lords States-General upon the question of jurisdiction, the Massachusetts Bay Colony played the part of the dog in the manger. In 1633 Plymouth was at Windsor, side by side with New Amsterdam in the race for pelf and peltry. The influx of Massachusetts emigrants soon after crowded both the rivals to the wall. The correspondence between Governor Bradford and the Massachusetts authorities shows too much ill-temper for the successful preservation even of the usual devout forms of expression. Plymouth colony had planned to remove bodily to the lands thus wrested from her. But of contention she had already had enough at Kennebec. It was feared, as Hubbard says, that "they all and the Gospel might be brought under the reproach of cutting one another's throats for beaver." David Peterson DeVries' account of his visit in 1639 to the Dutch fort, "The Hope," at Hartford, affords a lively picture of the numerous undignified squabbles between the Dutchmen and their English neighbors. There is an amusing story of the international fraternizing over a feast of cherries at the Dutch fort, and of the escape of a drunken Englishman from the whipping-post on account of that temporary era of good feeling. The Dutch cherry trees unfortunately could not bear fruit all the year round. Ill-feeling increased in intensity until the seizure of the fort in 1653, and its sequestration two years later.

II.—*The Massachusetts Bay Colony at Connecticut.* Out of a political and religious fermentation which pervaded every portion of the Massachusetts Bay Colony, there arose a social element, demanding democratic reform in the State, and Separatist reform in the Church. The political defeat of Winthrop and the colonization of Connecticut were two prominent results of the new movement. The central figure in the popular party during the conflict was the Rev. Thos. Hooker, the father of Connecticut. He was self-centered, magnetic, and a firm republican. In mildness he was surpassed by the even-tempered Winthrop, but his warm sympathies inspired him with a belief in the People that seemed foolish to the sagacious Governor. In public spirit and tolerant disposition he shows to advantage by the side of his rival, "the flexible Cotton." Against the conception of Roger Ludlow's character embodied in the new edition of Bancroft's "History," a protest must be filed. The testimony of his own life proves him to have been a selfish, ambitious, vindictive man, doomed to be rejected in the end by both Massachusetts and Connecticut. The democratic tendencies which are traced throughout Connecticut's constitutional development provoked much dolorous moralizing from Winthrop, who mourned that Mr. Hooker's work must "lack the blessing." Connecticut's treatment of Indians deserves a special word of commendation. Such has been the magic force of legend and of poetically inspired school-histories, that, for a century, the youth of America have heard, with awe and shame, the voices of the Delaware redskins, chanting "We will live in love with William Penn and his children, so long as the sun and moon shall shine." More than one colony surpassed Pennsylvania in a policy of kindness to the savages. Connecticut Indians live to-day upon lands that belonged to Sachem Uncas. During the contentions with Massachusetts that ensued upon the quarrel with Magistrate Pyncheon of Springfield, Connecticut appeared as the first American champion of the doctrine of "Home-instructions to representatives." A view of the economic life of the colony down to the time of the Revolution justifies that impression of slow and sure growth which is suggested in Connecticut's sobriquet "The land of steady habits."

III.—*The Colonies of New Haven and Saybrook.* A survey of the early fortunes of New Haven and Connecticut reveals the former declining from affluence to comparative poverty, while Connecticut rises from distress to comfort and power. The causes of these phenomena are to be found, not in New Haven's peculiar polity of the Church and State, but in economic conditions, in the fruitless endeavors to build a commercial metropolis on the edge of a wilderness. The complete history of the Saybrook Colony has never been written. The story is one of attempts, not of realizations. It was the only endeavor to colonize Connecticut under English chartered rights. The prospects of the colony and the purposes of its owners, Say and Sele, Pym, Hampden, Saltonstall, and the rest, varied with the fluctuating fortunes of the Puritan party in England. The first settlement was made, not at Saybrook, but at Windsor, in 1635, by Sir Richard Saltonstall's company. The letters of the knight bear abundant witness to the utter overthrow of the new foundation by the in-rushing tide of Massachusetts immigration. His just claims were finally satisfied in 1642. Massachusetts tried to use the Saybrook colony as a lever for weakening the independent position of Connecticut. The younger Winthrop's authority as Governor of Saybrook facilitated this purpose—until the time of the arrival of Col. Fenwick. Fenwick's expectations became disappointments, and, in 1644, after a separate existence of nine years, Saybrook was absorbed by the colony of Connecticut farmers.

BIOLOGY.

List of Coleoptera found in the vicinity of Baltimore. By O. Lugger.

[Abstract of a paper read before the Baltimore Naturalists' Field Club, January 16, 1884].

Although lacking a large river, the banks of which have proven everywhere such an excellent field to collect specimens of natural history, and which are always rich in species of beetles, the vicinity of Baltimore is by ans an unfavorable locality for coleoptera. Nearly every variety of d surface can be found within a short distance from this city. High ooded hills with steep or gently sloping sides; broad valleys and nar- ivines, with many streams and thousands of springs; rocky hill-sides ndy spots abound everywhere, and produce all the necessary conditions e existence of animal and vegetable life, thus affording a very rich or the collector. The districts along our tidewater again are the homes ay species not found elsewhere in this vicinity.

the usual methods of catching beetles have been resorted to. Sieving, g, sweeping, and the different traps in vogue among coleopterists, all produced their share of species in the following list. They have een bred in cages constructed for this purpose. By collecting very in spring and late in autumn, and even during sunny days in mid- , many species were obtained that belong to the Canadian fauna, and otherwise could not be found in this vicinity.

following list is the work of eight years' collecting, and contains 2259 s. It includes by no means all the species that can be found in this , and judging from those found near Washington, fully 700 more e found in time.

arrangement of families followed in this list is that of the late Dr. te and of Dr. Horn, published two years ago by the Smithsonian ution.

milies.	*Gen.*	*Sp.*	*Families.*	*Gen.*	*Sp.*	*Families.*	*Gen.*	*Sp.*
elidæ	2	25	Nitidulidæ	20	43	Chrysomelidæ	67	190
dæ	62	258	Trogositidæ	4	10	Bruchidæ	2	15
dæ	2	5	Monotomidæ	4	8	Tenebrionidæ	35	59
dæ	14	46	Lathridiidæ	3	7	Cistellidæ	7	17
dæ	2	5	Derodontidæ	1	1	Lagriidæ	2	3
philidæ	13	37	Byrrhidæ	4	5	Melandryidæ	17	25
æ	11	29	Georyssidæ	1	1	Pythidæ	2	2
enidæ	2	11	Parnidæ	5	10	Oedemeridæ	4	8
nidæ	12	26	Heteroceridæ	1	8	Cephaloidæ	1	1
linidæ	65	204	Dascyllidæ	10	22	Mordellidæ	5	40
pterygidæ	5	5	Rhipiceridæ	2	3	Anthicidæ	9	28
llidæ	3	6	Elateridæ	35	106	Pyrochroidæ	2	4
ridæ	3	6	Throscidæ	2	3	Meloidæ	8	14
phidæ	5	6	Buprestidæ	17	58	Rhipiphoridæ	3	6
ellidæ	17	33	Lampyridæ	24	55	Rhinomaceridæ	1	2
ychidæ	7	11	Malachiidæ	5	12	Rhynchitidæ	4	9
dæ	7	24	Cleridæ	12	29	Attelabidæ	1	3
dæ	11	15	Ptinidæ	21	31	Otiorhynchidæ	12	12
didæ	2	2	Cupesidæ	1	2	Curculionidæ	61	165
iæ	9	22	Cioidæ	4	5	Brenthidæ	1	1
phagidæ	7	8	Lucanidæ	5	6	Calandridæ	10	22
phagidæ	5	15	Scarabæidæ	43	143	Scolytidæ	19	32
stidæ	7	15	Spondylidæ	1	1	Authribidæ	9	15
idæ	13	45	Cerambycidæ	74	163	71 families,	857 gen.,	2259 sp.

PETROGRAPHY.

eliminary Notice of the Gabbros and associated nblende rocks in the vicinity of Baltimore. By G. VILLIAMS.

riew of the limited number of occurrences of typical gabbro which have ar been described within the United States, it may be interesting to notice two well marked types of this rock that are to be found in the diate vicinity of Baltimore. Inasmuch as their mode of occurrence ses to throw additional light upon one of the much mooted questions haean geology, viz: the origin of lenticular bodies of hornblende rocks, en interbedded in the old gneisses, the full description of these gab- which their geological importance warrants, must be postponed until e complete study of their field relations is possible.

irregularly oval area to the west and northwest of the city of Balti- whose greatest length, extending from the Patapsco River to Smith's e, is about 10 miles and whose greatest width is about 5 miles, is covered a compact black rock, locally known as "Niggerhead." Although at ight this all seems to be alike, a more careful examination reveals the hat there are three altogether distinct kinds of rock within this area. r the most common of these is a very compact mixture of dark green lende and anorthite, which frequently shows unmistakable signs of fication. Associated with this rock, which we will call an *anorthite bolite*, is another of a dark purple color and quite massive in its cter. This latter is most frequent toward the centre of the area, its xposures being along the line of the Western Maryland Rail Road Mount Hope. It seems to occur in irregular patches of all possible dimensions, always surrounded by the amphibolite, between which and it there is never a sharp line of contact, but everywhere a gradual transition.

A microscopic examination of the purple rock from all the principal points of its occurrence shows that it is an exceedingly fresh, fine grained mixture of triclinic feldspar, diallage and hypersthene, with accessory hornblende, magnetite, apatite, and very rarely olivine. Its structure is altogether granular or granitic, and the rock is therefore to be defined as a *hypersthene gabbro* or *hyperite*. The feldspar was isolated and proved to be from both an optical and chemical examination, bytownite, a member of the triclinic series between labradorite and anorthite. It is not otherwise remarkable, except for the presence of beautiful inclusions, so characteristic of the feldspar of gabbros. The diallage is without crystalline form, of a light green color in the section and devoid of all pleochroism. The hypersthene, whose orthorhombic character is easily proven in cleavage pieces, is strongly pleochroic, the colors being arranged as usual, and contains its characteristic inclusions in great perfection. Aside from these essential constituents there is often present a brownish-yellow hornblende, which is undoubtedly original and not paramorphic in its nature, as is abundantly proved by its occurrence in the freshest and most unaltered specimens, and the fact that it is of a totally different character from the really paramorphic hornblende to be described farther on.

The hornblende rock or anorthite amphibolite retains throughout the entire area a constancy in its petrographical character quite remarkable for a member of the crystalline schists. The only observable differences are slight local variations in the coarseness of grain and distinctness of stratification. It always shows in a hand-specimen a satiny lustre, and is seen under the microscope to be composed of a triclinic feldspar and confused aggregates of amphibole, possessing the green color, strong pleochroism, and all the other properties of common hornblende. The feldspar was isolated and found to be nearly identical with that of the gabbro, although in the special specimen examined, slightly more basic. In its chemical constitution and optical properties it agreed better with anorthite than with bytownite. Epidote was frequently observed in nearly colorless crystals, generally forming a rim around and projecting into the feldspar. Quartz is very rarely present, and never except in minute quantities.

It will be seen at once that the association of these rocks is precisely similar to that at several well-known European localities, where they have of late been the subject of much careful study. Near Rosswein and Penig in Saxony lenticular masses of hypersthene gabbro occur imbedded in hornblende schists, and from their peculiar structure are called "Flaser-gabbros." Naumann regarded them as eruptive, but Stelzner, Credner, and Dathe consider them as metamorphosed sediments. Reusch has lately described the same association and structure at Bergen in Norway, where he considers the rocks to be metamorphosed lava streams and tuffa beds. Becke has also described the same formation in Austria. The Baltimore gabbro area gains therefore much in interest by its close similiarity to these classic European localities.

Whether the shape of the masses of fresh hypersthene gabbro in the Baltimore region is as a rule lenticular or not, it is difficult to say. If they are, the great size of the larger ones and the steeply tilted position of the hornblende beds would cause them to appear rather as alternating bands, and in the case of the smaller masses the close similarity in the general appearance of the two rocks and the absence of any sharp line of contact between them renders the assigning of any definite limits to such masses nearly impossible. The general impression conveyed is that of quite irregular patches of gabbro occurring in the compact amphibolite and everywhere passing by imperceptible gradations into it.

The association of these two rocks is so intimate and the transition of one into the other so gradual, that the idea of the subsequent origin of the gabbro, as a mass intruded into the amphibolite, is out of the question; on the other hand they both retain their essential characteristics throughout the entire area, in spite of their intimate mixture, with far too much constancy to allow of the supposition that they were originally interstratified sedimentary beds whose different constitution furnished, when metamorphosed, these two different products. In fact the separation of these rocks has only a petrographical interest. Geologically they form one body as is shown, aside from their close field relations, by the great similarity of their chemical composition and the fact that the area they occupy is so sharply defined against the gneisses and mica schists which surround it. Whatever may have been their primary origin, they are essentially the same rock, and the idea naturally suggests itself that one may be an alteration product (not however a decomposition product) of the other. Now the molecular change of hornblende into augite is known to take place only under circumstances of complete fusion, whereas no phenomenon is better known in petrography than the corresponding change under ordinary conditions of augite to hornblende. The identity of the feldspar in both rocks makes the only real difference between them, the replacement of the pyroxene constituents, diallage and hypersthene, in one by aggregates of green hornblende needles in the other. The idea then that the hornblende was the paramorphic product of the pyroxene lay close at hand, and the study of several series of thin sections made from chips taken at very close intervals along lines where the gradual transition of one rock into the other was especially manifest, have disclosed every step in this process of paramorphosis with great clearness. The pyroxene at first becomes fringed with a zone of fibrous hornblende which is colorless inside like tremolite, but on its exterior edge is somewhat more compact and possesses the usual green color and pleochroic properties of ordinary hornblende. This process of alteration goes on until the pyroxene is altogether replaced by irregular aggregates of hornblende needles, those in the centre being colorless and those on the edge green. The inclusions of the pyroxene have now mostly disappeared but those of the feldspar remain intact. A short distance farther away from the gabbro the hornblende aggregates have become altogether green and the feldspar no longer presents its peculiarly fresh appearance, the characteristic inclusions have disappeared, and it is filled with actinolite needles or fringed with epidote. This process, though the usual one, was by no means the only one observed. Sometimes the hornblende, instead of being aggregates of compact green needles, retains that very fine parallel fibrous appearance characteristic of uralite. The process is also somewhat different if the gabbro contained original brown hornblende, which resists the alteration longer than the pyroxene, although it also appears finally to go over into the green variety.

The microscopical study of these two rocks, then, as well as their field relations, as far as these have yet been deciphered, seems to indicate that they are essentially the same and that the gabbro was the original type. What their primary origin was it is difficult to say, but the sharp line of demarkation by which this area is separated from the light-colored gneisses and mica schists which surround it render it at least very possible that the whole was an eruptive mass, intruded as gabbro, and subsequently partially altered by paramorphism to anorthite-amphibolite. To this theory the more or less perfect schistose structure of the latter rock presents no serious objection. The great lateral pressure to which, as the microscope plainly shows, these rocks have been subjected would naturally have tended to produce a schistose structure resembling slaty cleavage. In fact this pressure may have been the very cause of the alteration of pyroxene to amphibole, which would account for the schistose structure being most manifest where this alteration is most complete.

The third of the rocks mentioned as occurring in the particular area under discussion is altogether different in character from the two already described. In its freshest state it is composed largely of olivine together with considerable diallage and bronzite and very little feldspar. It may perhaps best be classed as an *olivine bronzite gabbro*, although the almost total absence of feldspar in some varieties would throw it into the family of the *peridotites*. Macroscopically this rock appears as a dark brown base in which large plates of yellowish bronzite and smaller glistening crystals of black diallage together with a few scattered specks of white feldspar are readily detected with the unaided eye. Under the microscope the base is seen to be composed altogether of olivine and smaller grains or shreds of magnetite separated out in the process of serpentinization, which has always commenced and some cases progressed very far. Neither the bronzite nor diallage present any marked peculiarities. Both are nearly destitute of pleochroism in a thin section, but are readily distinguished by their difference of size, color, and optical orientation. The feldspar is anorthite and is interesting as showing a rare form of alteration into some zeolite mineral instead of into calcite or kaolin as usual. This zeolite, whose exact nature has not yet been determined, forms aggregates of fibrous crystals resembling natrolite and is perhaps scolecite. This feldspar also exhibits in great perfection the border of actinolite (?) fibers, described by Törnebohm, produced by the mutual reaction between the olivine and feldspar substance wherever these come in contact.

This rock occurs at several localities within the gabbro area, generally in the form of narrow bands resembling dykes, though sometimes in masses of considerable size. It is often associated with serpentine which has plainly originated from its alteration, and suggests the idea that the large mass of serpentine forming the Bare Hills, about 7 miles north of Baltimore, may have also originated in the same way. At all localities where it is at all fresh the olivine gabbro retains its main character with great constancy. From the following chemical analysis of this rock by Dr. Leroy McCay of the Green School of Science, Princeton College, it will be seen that it must be peculiarly subject to alteration. Besides its change to serpentine, it is seen sometimes to pass over into a light green talcose rock, which also occurs alone in bands cutting the hypersthene gabbro, and whose presence in this form is thus explained:

SiO_2	41.00
Al_2O_3	7.58
Fe_2O_3	5.99
FeO	4.63
CaO	10.08
MgO	23.59
Na_2O	.52
CO_2	3.62
H_2O	4.73
	101.74

This is to be regarded as only a preliminary notice of the gabbros about Baltimore. The writer hopes before long to publish a more detailed account of them with illustrations and a number of chemical analyses.

On an excursion Map of Baltimore and its neighborhood.

By A. L. Webster.

At a meeting of the Baltimore Naturalists' Field Club, March 19, 1884, Mr. Webster made a report upon a map of Baltimore and its neighborhood soon to be published for the use of the students of the Johns Hopkins University, of which the following abstract has been prepared.

From the first organization of this Club the want of an accurate and reliable map of Baltimore and its neighborhood has been felt by its members.

The results of their excursions and studies have rolled up a large collection of facts of importance, relating to the distribution of plant and animal life, of physical and topographic peculiarities, and of geological structure.

As notes on these items of interest have accumulated, the need of a comprehensive chart of the area under study has increased proportionately, but something more than a mere excursionists' guide is required, though this is a great desideratum at present.

The classification and systematizing of material must be preceded by the accumulation of a vast number of facts the significance of which, when first presented, is frequently hidden or but hinted at, and only brought into relief by association with others subsequently developed. To prevent the loss of such facts, relating to the physical geography and natural history of the district, through misconception of their importance, a large central chart accessible to all on which to record by a system of cartographic devices each item as noted, is urgently required.

As the delineation becomes more complex it will be beyond the power of a single map to carry the growing load of information, but by a division of the burden and a grouping of great classes of material on independent but similarly prepared base maps, a clear and comprehensive graphical statement can be preserved and a ready means offered of incorporating the new results of advancing study.

With a view to ultimately obtaining such a store house for the fruits of the Field Club's labors a movement was recently made to search out existing maps of the city and its surroundings, to ascertain to what extent they supplied the deficiency and to determine upon the most feasible course toward the ultimate accomplishment of the perfected plan.

A large number of maps of the city, the neighboring counties, and the state were examined without bringing to light any publication suitable to the ends noted. Sufficient scattered material was found, however, from which a serviceable map could be compiled.

A report to this effect was presented to the Trustees of the University with an urgent request for assistance. This was very kindly received and permission granted to have the work begun.

The area to be mapped lies approximately between latitudes 39°-06′-30″, 39°-28′-30″, and longitudes 76°-21′-30″, 76°-51′-00″, and is bounded by a square of twenty-five miles side, the centre of which is the city hall.

Something more than one-fourth of this area has been covered by the accurate triangulation and plane-table work of the U. S. Coast and Geodetic Survey. The remainder has at various times been surveyed and mapped, with more or less accuracy, by numerous engineers; the results of whose work are to be found in atlases of the city of Baltimore, of many of the counties and of the state; as well as in the form of wall-maps, pocket-maps, guides, etc., etc. With the exception of the work of the Coast Survey however, the measurement of altitudes has generally been overlooked.

It was also found that the U. S. Geological Survey is at present compiling a map of the District of Columbia and adjoining country on a scale of two inches to the mile, with twenty foot contours.

The area covered by this work lies between latitudes 38°-47′, 39°-05′, and longitudes 76°-50′, 77°-18′.

Its contiguity to our own limits and the desirability of mutual harmony in scale and general plan is apparent.

With these facts in mind it was decided to have drawn on a polyconic projection with scale of 1: 31,680., or two inches to the mile, a map taken from material furnished by published and official records of the U. S. Coast and Geodetic Survey. This drawing is to serve as a basis for the entire work, but in itself is to remain untouched until results of work of equal standard accuracy can be obtained to join with it. The computed geographical positions of one hundred and forty-four points lying within the district have been furnished by the courtesy of the Survey. From the drawing a tracing is to be made to which material gathered from the most reliable published maps of the remaining area is to be added. By the kindness of the U. S. Geological Survey the reduction of these various plats to the uniform standard scale is being effected by the process of photography and from the resulting prints features desired are transferred to the tracing.

Photolithographic reproductions of the finished tracing, reduced and properly mounted, will serve as convenient pocket-maps for use in the field.

It is to be borne in mind that they will be merely the results of compilation from a variety of sources, the best however at present existing. Many errors will doubtless be found in them, due to inaccuracies in the originals, but it is for the correction of these errors that they are produced.

The tracing is to be hung in an accessible place and items of interest to the various sections or corrections of detected inaccuracies, are to be made upon it or copies of it, from time to time, in accordance with a prescribed plan and system. It will accordingly represent the sum total of information collected up to date.

As existing hypsometric material is worked over and new records made, contours will be introduced, and it is hoped another edition showing the topography in relief will be produced in the future.

To the kind coöperation of the U. S. Coast and Geodetic Survey, the Corps of Engineers of the Army, the U. S. Geological Survey, and various friends much of the progress of the work is due.

REPORTS OF RECENT LECTURES AND ADDRESSES.

VII. Dr. Billings's Lectures on Municipal Hygiene.

Dr. John S. Billings, Surgeon U. S. A., who has been for several years the medical adviser of the Trustees of the Johns Hopkins Hospital in respect to the construction of their buildings, gave in Hopkins Hall during the first half-year, a course of twelve lectures on Municipal Hygiene. The following abstract has been prepared by Mr. Albert L. Webster, Fellow by Courtesy of this University.

Statistics clearly show a growing tendency on the part of the populace of this country to accumulation in cities; the sanitation of cities, therefore, is the sanitary problem of to-day. Apart from all other considerations, the importance of exertion in behalf of the health of the city as a whole, commends itself to our consideration on the ground of individual, self-preservation; on the common business principle that it will pay.

The annual number of deaths in Baltimore is now nearly 9,000, having been for the last two years over 2½ per cent. of the population. If we can prevent only one-tenth of this—that is reduce the rate to 2¼ per cent., or 22.5 per thousand, which certainly can be done, we shall save nine hundred lives, and get rid of one thousand eight hundred sick, who are a constant burden and expense. The money value of this is over a million dollars. The recent experience with small-pox cost the City Treasury over $90,000, to say nothing of the cost of the deaths, and of the sickness to individuals, or the loss to the business of the city, due to the prevalence of the disease. Yet this epidemic might have been prevented at comparatively small expense.

The impulse given to the study of municipal hygiene during the last forty years is largely due to the increased consideration of vital statistics. The figures representing the mortality of a place, are not by themselves the best test of its sanitary condition, but they are, upon the whole, a very good test, and often the only available one.

The importance of accurate and complete vital statistics is but slightly recognized in this country, and the dependent mortality rates accordingly open to more or less doubt. The most fruitful cause of error is connected with the mode of estimating the average living population which has furnished the deaths for a particular period.

The case of Baltimore illustrates the diversity of results attainable by different methods. The population of the city according to the United States Census of 1880 was 332,313. By consulting previous records and applying the ordinary method in use by statisticians, of reckoning proportionate increase in corresponding intervals, the population, June 1st, 1883, would have been 354,720.

The City Health authorities believe these figures to be too small and refuse to accept the census of 1880, estimating the population at that time to have been 393,796, or over 61,000 more than the census, a deficiency in the latter, according to them, of over 15 per cent. Their estimate is based upon the following considerations:

"There are 80,000 registered legal voters in Baltimore; five inhabitants to a legal voter is a fair and reasonable allowance, which would make the population 400,000. The census taken by the police, for our School Board, of children between the ages of six and twenty-one years gave 86,961. This would be a fair estimate of one-fifth of our population, making the same 434,805. . . . Again, there are 90,000 houses in Baltimore. Deduct 10,000 for manufacturing establishments, warehouses, stores, and unoccupied dwellings, estimating five inhabitants to each house (a very low estimate), our population would be 400,000." *

The results of an application of these same methods to the computation of the populations of other cities, and conversely the application of the usual methods of other cities to Baltimore, strongly concur in endorsing the figure obtained by the United States Census.

From the consideration of vital statistics, the following facts are made clear. Large cities have a greater mortality than small ones, and the latter than rural districts. Cities are more dangerous to male than to female lives and especially is this so among children; an excess of female mortality belongs exclusively to rural population. The birth and death-rate is higher among the colored than among the white population.

A large city covers a large area and influences affecting mortality rates vary with different districts lying within this area. Thus, for Baltimore the mean mortality rates for the years 1879–81 inclusive, for the various wards was as follows—

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* A. R. Carter, letter in *Sanitary Engineer*, Feb. 15th, 1881, p. 130.

Table Showing the Population and Deaths by Wards of the City of Baltimore for Three Years.

Wards.	Total Population.	Number of Deaths.				Ratio per 1,000.
		1879.	1880.	1881.	Mean.	
1	27,190	578	681	668	609	23.6
2	14,097	294	417	489	400	28.4
3	12,985	313	330	336	326	25.1
4	9,521	202	205	226	211	22.2
5	12,966	307	300	354	320	24.7
6	15,402	433	406	429	423	27.4
7	27,327	619	687	748	685	25.0
8	14,250	306	346	308	320	22.5
9	6,970	232	265	332	276	39.6
10	9,533	230	244	202	225	23.6
11	12,492	182	191	225	199	15.9
12	14,747	270	268	293	277	18.7
13	10,358	220	244	273	246	23.7
14	11,206	258	309	336	301	26.8
15	14,664	408	431	451	430	29.3
16	19,867	445	486	599	510	25.6
17	18,220	476	430	598	501	27.5
18	29,037	653	638	679	657	22.6
19	30,941	656	608	735	666	21.5
20	20,532	536	555	535	542	26.3
Total.	332,305	7,618	8,041	8,816	8,153	25.2

One of the most important factors affecting the health of a city is its water supply. Rain water is not pure water, as it contains impurities washed from the atmosphere, and from the roof which collects it and turns it toward the cistern. Well water in cities is specially objectionable, owing to the practical impossibility of protecting it from contamination. The supposed "sulphur springs" discovered a few years ago in Baltimore and Washington were but wells of dilute sewage.

Natural reservoirs and their outlets, pure running streams, are the best sources from which to draw the water supply of a city and the importance of preserving them in their natural state of freedom from filth is apparent, though not infrequently sadly overlooked.

Water pollution is of less interest to Baltimore than most cities, because the sources of our supply are unusually free from danger of contamination. Yet a small degree of danger exists, and the authorities must see that it does not increase, and that no prescriptive right to discharge refuse into the Gunpowder and its tributaries be established, for no matter how clear the law, there will be difficulties in removing a factory or drain when once established. The trouble is that the city has no jurisdiction over the greater part of the territory from which its supply is obtained. An appeal for protection to the last Legislature failed, the interests of about forty persons outweighing those of 400,000.

Next in importance to the purity of water supply stands the removal and disposal of refuse, ashes, garbage, street sweepings, excreta, foul water, etc.

There are two ways of dealing with it: the ancient, uncivilized way, leaving to the individual householder to get rid of this refuse as best he can; and the co-operative plan where the city undertakes the business. By the first, the greater part of the refuse is kept within the town, in cesspools, yards, or streets, to be disposed of by nature's scavengers.

A very large amount of evidence has been collected, proving that no population living among cesspool emanations can continue to be healthy.

Attempts to prevent soil-pollution by making the cesspools water-tight have proven failures, and involve expensive methods of removal. Such has been the experience of Paris. The annual cost of emptying the 60,000 cesspools of Baltimore—those, that is, that fill up—is about $100,000. The odorless excavating company's vacuum apparatus is employed in the removal of about one-third, the other two-thirds or more sink into the soil. The best water-closet will not be used in a cesspool city, because using much water they fill the vaults too quickly.

The abundance of water in American cities, and the necessity of disposing of the water fouled by domestic use places the water carriage system of sewerage far in advance of other methods for use in this country. The system involves three things: 1, the conveying away of polluted water; 2, drainage of subsoil; 3, removal of surface drainage, and most of the disputes upon this subject turn upon the question of how far these three objects are to be combined in one system.

Small natural water-courses have often been utilized for drainage. These gradually become polluted and offensive by refuse and filth, as in the famous Bayou Gayoso, of Memphis, and when this has progressed so as to constitute a nuisance, the stream is often arched over and called a sewer. But the functions of the two are incompatible.

The proper connection of house fixtures with the sewers is vital to the complete efficiency of the latter.

The refuse and excreta discharged into house drains are not necessarily dangerous to health if they be removed before putrefaction begins. But when, on account of defects in the pipes or traps or of that abominable plan, in which a cesspool beneath the house or in the yard is so connected with the sewer that the overflow only passes off, the sewage reaches the sewers in a state of decomposition, then the sewers must become offensive, no matter how perfectly planned or constructed. This arrangement is common in Philadelphia, and is by no means wholly unknown in Baltimore.

In a properly constructed system of sewers there is little danger from sewer gas, and in improperly constructed ones the danger can be prevented as far as house drains are concerned by means of a proper trap between the house and sewer, and by ventilating the sewers. Probably more offensive gases are produced in soil pipes than come from sewers. Pipes connected with house drains should be arranged according to the following principles, which are simple, but which involve sometimes a difficulty in their practical application. Every fixture through which foul water is to pass shall have a trap as near the fixture as possible; all the traps should be ventilated; the soil pipe should pass out through the roof, full size and be freely open at the top; and in most of our cities, as actually built and sewered, the communication of the air in the soil pipe with that in the sewer should be cut off by a trap on the house side of which should be placed a fresh air inlet. The best traps are those known as the S and half S traps, simple bends in the pipe.

The pre-eminent function of the perfect sewer is to remove with all possible speed offensive refuse without in itself becoming contaminated or offensive. Various so-called systems have been devised to effect this end. The combined system provides by a single line of conduits not only for the removal of house refuse and waste water, but also for the street water in times of rain. This, from several considerations, is a matter of doubtful advisability.

The separate or double system provides independent channels for rain and house water. The latter being carried by small pipes can be readily flushed and kept free from deposits of decomposing filth. The Lieurnur system is a small pipe system in which the excreta is forced by pneumatic pressure to a central collecting station and there disposed of. The expense of construction and maintenance of this system argue strongly against it, aside from other considerations.

As to the paving of streets, cities having heavy traffic, generally pave with blocks of trap rock or granite, known as Belgian blocks, laid in juxtaposition on a bed of sand or gravel. The objections to these pavements are that the bed of gravel and subsoil gradually becomes polluted with organic matters derived from the excreta of animals, all of which in hot and dry weather give rise to offensive and dangerous gases. The best foundation is one of cement concrete. It prevents pollution of subsoil, gives elasticity, which is desirable to prevent injury to vehicles and animals, it distributes the weight and shock of traffic evenly over the surface, and it becomes better and stronger as it grows older. Stone, wood, or asphalt may be laid upon this foundation, but wood is objectionable from a sanitary standpoint. The report of the city commissioner of Baltimore for last year contains communications from several civil engineers relative to the policy to be pursued to secure good pavements. They consider the matter from the technical standpoint of their profession without reference to sanitary considerations, and all recommend the granite block. The cobble-stone pavements which cover most of the streets of Baltimore are much commented on by strangers, and two or three hours' experience produces impressions far from agreeable. The best pavement where there is little heavy traffic is one of asphalt laid on concrete.

With special reference to the sanitary requirements of Baltimore, I should recommend to the authorities and people of the city that more elaborate health statistics be collected and compiled; that the water supply be protected by municipal and State co-operation; that connections with sewerage be made under city supervision; that cesspools be filled; that there be an increase in plumbing inspection; that cobblestone pavements be removed; that an abattoir be constructed; that schools be thoroughly inspected and scholars instructed in hygiene; that public baths be opened; that comfortable and clean tenement-houses be built, and that voluntary organizations be formed to see that these things are properly done.

VIII. Mr. Stillman's Address on the Acropolis of Athens.

The following is an abstract of an address by Mr. William J. Stillman before the University Archæological Society, on March 22, 1884.

The influence which the site of Athens had on Greek civilization was owing to its impregnable Acropolis in the midst of a magnificent plain which must in that time have been of great fertility, watered by two rivers, with access to the sea at no great distance, all conditions combining to increase wealth and give security to its civil liberty and to the results of its material prosperity. The rock of the Acropolis is one of the most singularly difficult of access amongst all the ancient cities, the only open road to it having been that which winds along under the southern precipices where now are the ruins of the Æsculapeion and the theatre of Dionysos. The western slope, by which it is approached by carriages, was probably in early times non-existent, and the valley between the Acropolis and Mars Hill much deeper, so as to make the western approach as steep as the others. And even in the time of Pausanias this is indicated by his itinerary. There were, however, two secret staircases carried through the rock, one coming up at the northern end of the Propylaea, and the other within the hieron of the Erectheum, the latter being that by which the Persians entered. These were probably part of the early works for the defence of the Acropolis, and are generally thought to have been Pelasgic, though the great work of defence of the Pelasgi, known as the Enneapylon, was probably on the south-western angle of the rock, covering the approach from the south. There is now no trace of the Enneapylon or of the walls of the Pelasgi, that which is shown opposite the temple of Niké Apteros being a comparatively modern wall supporting a terrace. The ancient entrance was, in all probability, where the present gate in common use, is, as is shown by the footprints of the beasts which were led up to the sacrifice, and which have worn the solid rock to considerable depth. The entrance was probably changed when the Propylaea was built and the gate on the western side constructed. This was ruined by Sylla and reconstructed in haste by Valerian at the approach of the Goths, and left as we now have it until the Turks converted the ensemble of the construction on this side into a huge bastion on which they planted their batteries. This bastion was removed by Beulé.

The buildings within the enclosure whose entrance was through the Propylaea are now the Parthenon and Erectheum, many smaller temples and shrines having probably been destroyed. The temple of Niké Apteros was without the Propylaea, and was demolished by the Turks and built into the bastion, to be, piece by piece, recovered and reconstructed in our century.

The description of the Parthenon included a demonstration of the well-known system of curvature of the horizontal lines, which, with the diminution in the inter-columniations and the convergence of the columns, the lecturer considered to be an expedient to increase the apparent size of the temple by exaggerating the perspective illusions. This was illustrated by diagrams and the effect of each variation from the regularity of construction was shown to bear directly on the perspective of the building so as to increase its apparent size.

The same points were illustrated by photographs taken by Mr. Stillman, in the foreground of one of which were shown a number of unfinished drums of the Parthenon columns which had been, from defects discovered after they had been brought up, rejected, and which still lie on a bed of fragments of marble covering the débris of the buildings destroyed in the Persian sack of the Acropolis. In this stratum of débris, which varied from two to six feet in thickness, and which has recently been excavated by the Archæological Society of Athens, are found many fragments of bronze and iron with carbonized wood; and, digging into the exposed face of the mass, the lecturer discovered many relics of the conflagration, amongst them a bronze archaic ornament (which he presented to the Society), and a deposit of barley, pease, and beans, which though completely carbonized by time, had not been burned and still retained their shape. An account of the Erectheum with its triple sanctuary, illustrated by photographs showing the various portions in all their views, completed the description.

IX. Mr. Clarke's Address on the Introduction and Fundamental Principle of the Entasis.

The following is an abstract of an address by Mr. Joseph Thacher Clarke before the University Archæological Society, on March 14, 1884.

This paper embodied original researches concerning the nature of the curved outlines of columns of round plan, based upon the suggestion of Thiersch: That the increased diameter of the middle shaft was introduced to overcome an optical deception resulting from the inability of the eye to distinguish a slight convergence in sets of lines apparently parallel. A comparison of those Athenian monuments which have been most accurately measured shows that the principle of this deception was fully understood by the Greek designers of the best period, and was determined by graphical methods. This recognition of the true character of the Entasis was entirely lost before the Renaissance, and replaced by Serlio and Vignola with clumsy and empiric makeshifts.

NOTES ON RECENT PUBLICATIONS.

Martin, H. Newell and W. A. Moale. Handbook of Vertebrate Dissection: *Part III.* How to Dissect a Rodent. (*New York: Macmillan & Co., pp. 85, 3 plates*).

"This little book, like its predecessors in the same series (*see notice on page* 59 *of Circular* 21) is designed for use at the dissecting-table, and not to take the place of attendance on lectures or the study of a text-book of comparative anatomy. We have assumed that the teacher or text-book will supply such references to original sources as it is desirable that students should be acquainted with, and have accordingly entirely omitted all such. As some critics of Parts I and II appear to have thought that such omission made it possible that the discoveries of others should be credited to us, we desire to state that, so far as we know, no new fact in mammalian or rat anatomy is to be found in the following pages, nor any novel method of dissecting. What we have attempted is to make it easy for a student to learn practically what a mammal, regarded from a morphological standpoint, is. In pursuance of this plan, details which are diagnostic or generally characteristic of mammalia have been treated with more fullness than generic or specific peculiarities.

"From a certain point of view the title of the book may seem a little absurd. The methods suitable for the satisfactory dissection of a rat would assuredly be quite inapplicable to the practical study of the anatomy of a whale or an elephant. But to the student who dissects, not to learn the detailed anatomy of any one species, but the common structural character of a class, it matters little which animal is selected if it be readily obtainable and fairly typical. A book giving directions for the dissection of any such mammalian species may be fairly entitled 'How to Dissect a Mammal.'

"Our choice of the rat was largely determined by its abundance and wide distribution, and the fact that no one is likely to object to the killing of as many rats as can be caught. The larger size of dogs and cats would have been to a certain extent an advantage, but domesticated animals are not to be easily obtained in such numbers as to provide a liberal supply of material for students. Further, we feel sure that he who aspires to become a comparative anatomist, and yet finds a rat too small for the observation of all the main facts in its structure, has mistaken his vocation."—*From the Preface.*

Hall, G. Stanley and Hartwell, E. M. Bilateral Asymmetry of Function. (*Mind, London, No.* 33, *pp. 17, 8°*).

This article consists of two parts, and is to be taken merely as a preliminary account of an attempt by the authors to study comprehensively and in accordance with modern scientific methods, the problem of the relation of right- and left-sidedness to the more general law of bilateral symmetry as regards form and function in animals, especially man.

Part I contains a summary statement concerning the facts observed in the fields of anatomy, physiology, pathology, clinical medicine, and zoölogy, regarding asymmetrical structure and unbalanced functions in paired viscera, limbs and sense organs, together with a brief review of the hypotheses offered in explanation of the facts.

A bibliography of the more important literature of the subject is promised by the authors.

In Part II it is stated that a consideration of the facts and opinions brought together in Part I has led the authors "to think that other methods than those hitherto applied might bring us into closer quarters with the comprehensive bilateral problem. Of these methods two were considered: 1. Operations on the corpus callosum and cerebellum of animals, and perhaps the pyramids, to partially isolate the action of the hemispheres, and also to reduce the action of one of them. 2. More accurate measurements of the bilateral asymmetry of function; especially as regards (*a*) the upper extremity, (*b*) the lower extremity, (*c*) binocular vision."

This section is devoted to an account of investigations made by the authors, according to the second method, applied to the arms. The description of experiments made and the statement of results which occupy the remainder of the section present no substantial differences from the results of the investigation recounted by E. M. Hartwell before the University Scientific Association, May 2, 1883, in his paper "On the Relation of Bilateral Symmetry to Function." An abstract of the paper referred to may be found in *Circular No. 25, p.* 149.

HALL, G. STANLEY. (*Editor*). Pedagogical Library, Vol. I.—Diesterweg's Methods of Teaching History, with papers by Professors Herbert B. Adams, C. K. Adams, John W. Burgess, E. Emerton, W. F. Allen, and Mr. T. W. Higginson. (*Boston: Ginn, Heath & Co. xii, 208 and 92 pp. 12mo.*)

This book is intended to be the first of a series entitled a "Pedagogical Library," devoted to methods of teaching, one volume of which is to be occupied with each of the more important branches of study in grammar and high schools. History was chosen as the subject of the first volume from a conviction that no subject so widely taught in schools is, on the whole, taught so poorly. The editor in his preface urges the need of securing better instruction, first, by improving the special training of teachers of history, and second, by increasing the time devoted to instruction.

The book consists of three parts. The first half of it is occupied by a monograph on instruction in history, translated from Diesterweg's *Wegweiser zur Bildung für deutsche Lehrer*, in which the meaning and use of history, and various questions in regard to the method of teaching it, are treated with fullness. Part II consists of brief contributions by prominent American historical teachers. Dr. H. B. Adams describes the methods and results of topical study of history in his classes at the Johns Hopkins University and at Smith College, and calls attention to the utility of beginning historical work with the investigation of local life. Prof. C. K. Adams suggests some improvements in American historical teaching to be derived from the study of German methods, and explains the plans pursued in the School of Political Science of Michigan University. Prof. J. W. Burgess describes the system followed in the School of Political Science connected with Columbia College. Dr. E. Emerton, of Harvard, shows the advantages of an application of the seminary method to historical teaching in American colleges. An important page or two on the use which may be made of physical geography, and a few words by Col. Higginson on the reasons why children dislike history, conclude this portion of the book. Part III, by Prof. W. F. Allen, consists of classified lists of the most useful historical works in English and of selected topics for class use, with some suggestions as to the use of the latter.

J. F. J.

DIPPOLD, G. THEODORE. The Great Epics of Mediæval Germany. An Outline of their Contents and History. (*Boston: Roberts Brothers. 1884. 223 pp., 12mo.*)

This is a reprint of the first issue of the book of September, 1882. "Although no claim is made to present here anything like a history of Mediæval German poetry, it will be found that the subject, as it comes within the scope of the plan announced, has been more fully treated on the following pages than in any work hitherto published in this country or in England."—(*Extract from Preface.*)

AMERICAN JOURNAL OF PHILOLOGY. Edited by Professor Gildersleeve. Vol. IV. Whole No. 16.

Article I.—The Noctes Atticae *of Aulus Gellius.* By HENRY NETTLESHIP.

A large proportion of the surviving Greek and Latin literature consists of extracts and epitomes. The passion for making *florilegia* and miscellanies of all kinds began among the Romans in the first century after Christ and continued in activity for a long subsequent period. The *Noctes Atticae* of Gellius is only one specimen of the results which this passion produced. Prof. Nettleship gives a sketch of the life and career of Aulus Gellius, who belonged to a very old Italian family, was born about 123 A. D., was educated at Rome and studied at Athens in the time of Herodes Atticus. After his return from Athens to Rome he fell under the influence of Favorinus, an influence which extended at least beyond the time at which he entered upon professional life. What that professional life was Gellius does not tell us explicitly, but references are made to judicial functions. The title *Noctes Atticae* was given to the book as a record of the fact that Gellius began to make his collections during the long winter evenings of his student years at Rome. It is professedly a handbook of miscellaneous information; he aims at being comparatively popular. The attempts to enliven his lessons are amusing by reason of the uniformity of the devices employed. There are many marks of carelessness in composition, inconsistencies in the dialogue, re-introduction of the same interlocutor, extracts carelessly torn from the context, allusions to things the writer has nowhere mentioned, promises that are nowhere performed.

Prof. Nettleship then analyzes the whole book according to the subjects of which it treats, and discusses the sources from which Gellius derived his knowledge. The element of purely miscellaneous information is comparatively small and does not include much more than an eighth part of the whole work. A large part is given to philosophy, something to literary criticism, a respectable *quota* to history and Roman antiquities, more than a quarter of the whole to lexicography and etymology, and something considerable to grammar and textual criticism. Large as is the amount of discussion and information bearing upon philosophical questions, that devoted to lexicography, grammar, and criticism of text and style, by far outweighs it both in quantity and in value. The phenomenon is typical of the state of Italian taste and feeling. Only the antiquarian impulse retains any life. The age has no vigor of its own but builds the sepulchres of the prophets and waits for inspiration to rise from the past.

Article II.—On the Final Sentence in Greek. By B. L. GILDERSLEEVE.

Read before the Johns Hopkins Philological Association at their February meeting, 1884. (*See p. 73 of this Circular*).

Article III.—T. L. Beddoes, A Survival in Style. I. By HENRY WOOD.

Read before the Johns Hopkins Philological Association at their December meeting, 1883. (*See p. 76 of this Circular*).

Article IV.—Notes. 1. *John Evelyn's Plan for the Improvement of the English Language.* By H. E. SHEPHERD.

2. *Mercator, v.* 524. By MINTON WARREN. (*See p. 56 of Circular* 29).

Article V.—List of Irregular (Strong) Verbs in Béowulf. By JAMES A. HARRISON.

This number contains *Reviews* of *Guest's History of English Rhythms* by J. M. GARNETT, of *Gartner's Raetoromanische Grammatik, Ulrich's Bifrun's Uebersetzung des Neuen Testaments, Förster's Altfranzösische Bibliothek* by A. M. ELLIOTT, of *Mather's Aeschylus' Prometheus Bound* by — Y ——, of *Dunbar's Concordance to Aristophanes* by C. D. MORRIS, of *Engelbrecht's Studia Terentiana, Wölfflin's Archiv für Lateinische Lexicographie u. Grammatik*, and *Ribbeck's Emendationum Mercatoris Plautinae Spicilegium* by MINTON WARREN. Brief mention is also made of *Schuchardt's Kreolische Studien, Internationale Zeitschrift für Allgemeine Sprachwissenschaft, Weil's Harangues de Démosthène, Jebb's Oedipus Tyrannus*, the new edition of *Cauer's Delectus, Gitlbauer's Babrii Fabulae*, and *Fränkel's Quellen der Alexanderhistoriker*. The *Reports* give an account of *Englische Studien, Zeitschrift der deutschen morgenländischen Gesellschaft, Journal Asiatique, Deutsche Litteraturdenkmale.*

This number closes the volume. Vol. V, No. 1 (whole number 17), will contain articles on *Maximianus* by ROBINSON ELLIS, on the Nahuatl-Spanish Dialect by A. M. ELLIOTT, (see *p.* 74 *of this Circular*), Dr. BLOOMFIELD'S essay on *Irregular Vedic Subjunctives* (see *Johns Hopkins Circulars, p.* 6), a paper on *Researches in Cyrene* by F. B. GODDARD, and Professor HAUPT'S paper on the *Woman's Language* (see *Johns Hopkins Circulars, p.* 51).

Subscription price, $3 per annum, payable to the Editor.

THE NEW BIOLOGICAL LABORATORY

OF THE JOHNS HOPKINS UNIVERSITY.

The recently opened biological laboratory of the Johns Hopkins University is eighty-four by fifty-two feet in external measurement, and consists of three stories and a basement. It is built of Baltimore pressed brick; with steps, entry, window-sills, and band-courses of Cheat-river bluestone. A fact that at once attracts attention is the number and large size of the windows; as the laboratory is free on all sides, it is therefore very well lighted.

On ascending the front steps, and passing through the door, the visitor enters the main hall, from which a wide staircase ascends to the third story, and on which most of the rooms of the first floor open. This floor is given up to the regular class-instruction of students not engaged in special work. It has on it (see plan, fig. 1) a lecture-room with seats for sixty; a storeroom connected with this, for the keeping of diagrams and lecture-apparatus; an administration-room, the headquarters of the chief assistant; a preparation-room containining a supply of the reagents, specimens and material required for the daily practical class-work; and the large general laboratory, thirty-two by forty-eight feet.

The latter has windows on three sides. Around these sides runs a work-table, supported, independently of the floor, on brackets attached to the walls, and affording ample space for thirty students. If necessary, a second table can be set inside this, giving places for fifteen or twenty more. The centre of the room is in part occupied by a dissecting and a chemical table. The latter is supplied with the reagents and appliances for practical work in elementary chemical physiology. The dissecting table has a slate top, and is provided with a sink and water-tap between every two students. The inner side of the room has, against the wall, tables for scales and the warm-water oven; a large hood for the performance of chemical operations calculated to give rise to noxious vapors; and a dumb-waiter leading to the basement, on which articles can be sent up from the storerooms there when called for. Near the centre of the room is a chute, lined with plate-glass (so as to be readily kept clean), and passing direct to the furnace-room below. Through this chute all refuse is at once got rid of. The floor of this room, and of several others in the building, is of asphalt, and the walls of hard cement to a height of two and a half feet. Thus the floor can be flooded with water, and thoroughly cleansed whenever desirable.

The work to be done in this room annually is as follows: by the first-year students, a thorough macroscopic and microscopic examination of about twenty-five selected vegetable and animal organisms illustrative of the course of lectures on general biology, and a study of the embryology of the chick; by second-year students, a course in practical animal physiology and histology a little more extended than that given in Foster and Langley's 'Practical Physiology.'

The second floor (see plan, fig. 2) contains the following rooms: a laboratory for research and advanced study in animal morphology, and a corresponding room for botanical work (used at present as the laboratory of psycho-physiology); a photographing-chamber, with heliostat and other appliances for micro-photography; a library of biological text-books, monographs, and journals; a small lecture-room, capable of seating about thirty; an assistant's private room; a museum containing such typical osteological and other specimens as are needed by students pursuing the regular courses of class-instruction, and the beginning of a collection of the local fauna and flora, made by the members of the field-club; and a store and preparation room for the curator of the museum.

The third floor (see plan, fig. 3) is mainly given up to advanced students in physiology and histology. It has three large work-rooms; a dark chamber for spectroscopic work, for experiments in physiological optics, etc.; the director's private room; a room for the myograph; an assistant's private room; the mechanics' shop, for the construction and repair of instruments; and a small balance-room.

The building being heated by steam supplied from a boiler in the neighboring chemical laboratory, the basement (see plan, fig. 4), which is well lighted, is left free for use. The scientific work-rooms in it are a large, well-equipped room for advanced study in chemical physiology, a balance-room, and a room for the study of animal electricity. The basement also contains a suite of three rooms, which form the janitor's headquarters, where he has charge of the necessary stock of chemicals and glassware, and has also a carpenter's bench, at which he does any simple bit of carpentering required. From one of these rooms a shaft two feet square runs to the top of the building, communicating with each floor. Through this shaft it is intended to run wires to various work-rooms, transmitting electical currents for the running of chronographs, and for similar purposes. The shaft was also planned in the hope that ultimately the clock-work of kymographs and such instruments will be replaced by electrical energy generated by an engine and dynamo in the basement, and distributed thence over the building. The remaining rooms in the basement are, the 'animal room,' fitted up with tanks for the keeping of frogs, terrapins, and so forth; and the furnace-room. The latter contains a cremation-furnace, in which all the combustible *débris* of the laboratory is disposed of, and a boiler and condenser for the preparation of distilled water: it has also in it a small steam-engine, designed to be used for running a centrifugal apparatus.

In the general internal fitting up of the laboratory, the trustees of the university have acted upon the belief that it is, in the long-run, more economical to provide students with furniture which is good and attractive, and trust them to take care of it, than to supply cheap tables and cases, which the average undergraduate, at least, is apt to feel no hesitation in mutilating. The halls and lobbies are comfortably covered with cocoa matting; the tables, instrument cupboards, and cases of drawers are of polished cherry. But there has been no attempt at ostentation: the furniture is all simple; though handsome, and finished in every essential in the best manner. Every drawer runs as smoothly as in the best cabinet work; and each has its own lock, to be opened only by its own key, or the master-key for each floor kept in the administration-room.

The library is a little more luxuriously furnished than the other rooms. It is carpeted, and supplied with armchairs. So many students can only afford to hire rather uncomfortable lodgings, that it was believed desirable to provide in the library a really pleasant study, in which they might find at hand, not only the books they wanted, but writing-tables and other conveniences. None of the books are locked up. The student, on entering, finds before him a list of books which are not to be taken from the room, including text-books, monographs on the plants or animals which are used as types in the regular class-instruction, and the last-received numbers of periodicals: all other books may be taken (subject to call for immediate return at any time) on the student writing his name, and the title of the book he desires to take away, on a card provided for that purpose, and then slipping this through a slit in a locked drawer. The fellows and scholars in the biological department act in turn as librarians for the day, and are present at a stated hour to received books returned, and restore the receipts for them: until the card is returned to its signer, he is responsible for the book. This system of almost absolute freedom in taking books from the library is still on its trial: it has now been in practice for four months, and with the best results. Those who desire to take books home appreciate the trust reposed in them, and also the convenience to them of the present plan, and are anxious to secure its continuance.

The principle on which the library is managed, of inviting students to co-operate with the administrative officers in making it possible to allow the freest use of all books in it compatible with their safety, has been extended to the instruments in the various rooms for advanced work. On admission, each man has assigned to him a microscope, microtome, other histological appliances, and such chemical glass-ware as he is pretty certain to need. For these he signs a receipt, undertaking to restore the articles in good order on demand, or pay a specified sum for them. Glass slides and covers are purchased in quantity, and supplied by the janitor at cost. Other glassware, only occasionally needed, is supplied to any member of the laboratory on requisition, the recipient signing an agreement to return or pay for it. With these exceptions, free use of all the instruments required for such work as he has been permitted to undertake is allowed to every student, on condition that upon removing any piece of apparatus from its drawer or cupboard he shall leave in its place a card bearing his name. The only alternative, of course, is to lock every case, and only issue apparatus on formal application to a special officer. The men are on their honor, and also know, that, if instruments cannot be traced, the present system must cease. Hitherto the endeavor to secure their aid in carrying out this plan of making all the apparatus accessible with the minimum of trouble or delay, has had most satisfactory results; largely, no doubt, owing to the fact that the majority of the students are graduates old enough to have a sense of responsibility and to influence the younger men. Once a month one of the fellows, or graduate scholars, examines the instrument cupboards in each room, compares their contents with the inventory, notes what piece of apparatus has been taken and who has taken it. If any instrument is not accounted for, he posts a notice asking who has it. During the past four months the latter proceeding has been necessary only three or four times, when students had, in the hurry and excitement of an experiment, forgotten to write the required receipt: in every such case the delinquent has at once come to apologize and explain. What may be called the 'permanent' apparatus in the laboratory, as distinguished from glass tubing and other perishable 'current' apparatus renewed yearly, has cost more than ten thousand dollars: about fifteen hundred dollars are annually provided for repairing and adding to it. During the current year another five hundred dollars has been placed at the disposal of Dr. G. Stanley Hall for the purchase or construction of apparatus for psycho-physiological teaching and research. This stock of instruments is so valuable, and in many cases so easily injured, that a longer trial will, of course, be necessary, before it can be decided whether the present system of leaving every thing unlocked and trusting students to leave an acknowledgment for such instruments as they take, can be continued without undue risk of loss, or injury by carelessness for which no one can be found responsible.

The work for which the laboratory has been planned and built is stated in Professor Martin's lecture, (*see* p. 87 *of this Circular*). Briefly, it is to train beginners in biology in the fundamental properties of living matter, and the structural and physiological characteristics of the chief groups of plants and animals; in co-operation with the seaside laboratory of the university, to afford opportunities for advanced study and research in animal morphology and embryology; and, ultimately, similar opportunities for advanced students of botany. In addition, very special attention has been giving to providing facilities for class-instruction, advanced study and research in animal physiology and histology; and opportunity for such senior students as intend to become physicians to learn the methods of experimental pathological and therapeutical research, so far as they can be carried on in a laboratory. It is hoped that in this way the biological laboratory may prepare annually some students to enter special laboratories of pathological or pharmacological research more immediately connected with a medical school.—(*Reprinted from Science, March* 21, 1884.)

DIAGRAMS SHOWING THE ARRANGEMENT OF ROOMS.

FIRST FLOOR.

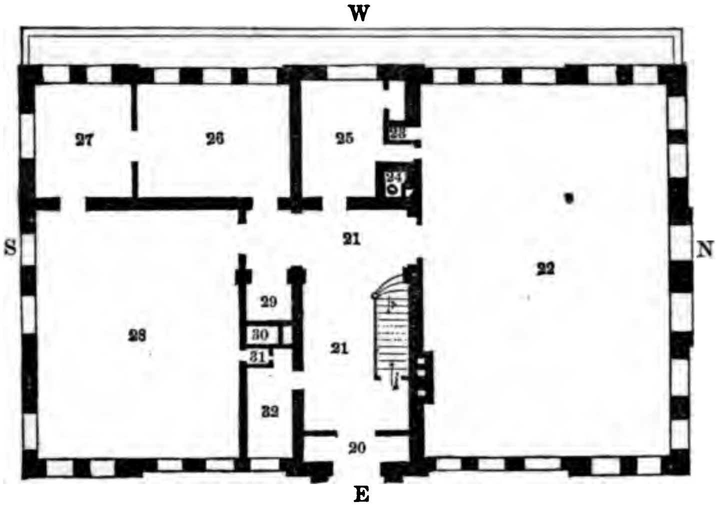

FIGURE 1.—20, vestibule; 21, main hall; 22, work-room for practical instruction of less advanced students; 24, 30, ventilating shafts; 25, storeroom of materials and reagents for general practical class-work; 26, chief assistant's room; 27, storeroom for diagrams and lecture-apparatus; 28, lecture-room; 29, elevator; 32, cloak-room.

SECOND FLOOR.

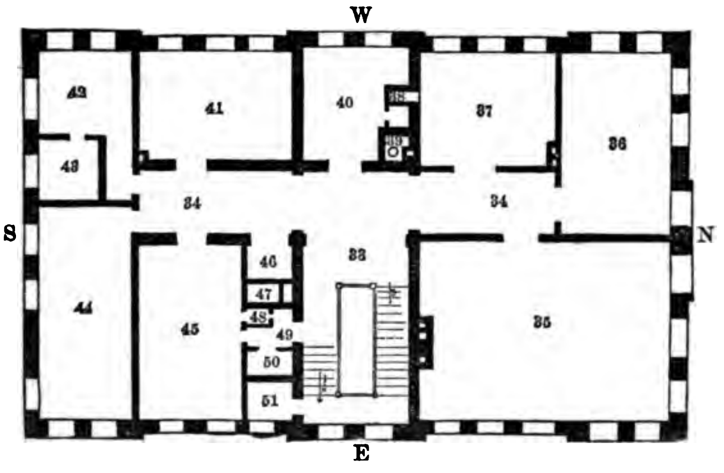

FIGURE 2.—33, 34, hall and corridor; 35, museum; 36, advanced morphology; 37, preparation-room for museum; 40, assistant's room; 41, library; 42, 43, photography; 44, advanced botany; 45, lecture-room; 46, elevator; 47, 39, ventilating shafts; 51, lavatory.

THIRD FLOOR.

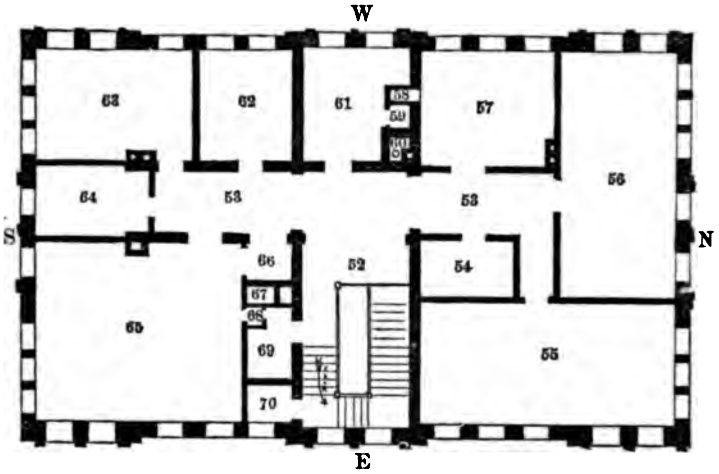

FIGURE 3.—52, 53, hall and corridor; 55, experimental physiology; 56, advanced histology; 57, workshop; 54, balance-room; 61, assistant's room; 62, myograph-room; 63, director's private room; 64, dark chamber; 65, experimental physiology; 66, elevator; 60, 67, ventilating shafts; 69, closet; 70, lavatory.

BASEMENT.

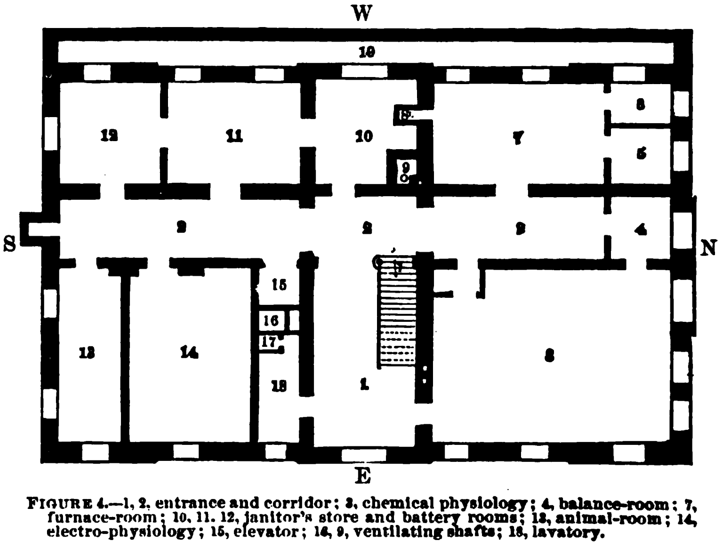

FIGURE 4.—1, 2, entrance and corridor; 3, chemical physiology; 4, balance-room; 7, furnace-room; 10, 11. 12, janitor's store and battery rooms; 13, animal-room; 14, electro-physiology; 15, elevator; 16, 9, ventilating shafts; 18, lavatory.

MODERN PHYSIOLOGICAL LABORATORIES:

WHAT THEY ARE AND WHY THEY ARE.

(AN ADDRESS DELIVERED ON THE OCCASION OF THE FORMAL OPENING OF THE NEW BIOLOGICAL LABORATORY OF THE JOHNS HOPKINS UNIVERSITY, JANUARY 2, 1884).

BY

Professor H. NEWELL MARTIN.

A little more than seven years ago I announced from this platform that the old biological laboratory was ready for use,—that set of rooms in the third story of this building, which, inconvenient in many respects as it was, will, I trust, always be remembered by some of us with affection, and mayhap with a little pride.

This night on which we have met to celebrate the completion of the new laboratory is an occasion for looking forward rather than back. But before proceeding to speak in detail of the new building, I feel sure I do what every one of the members of the biological department present would think me remiss to omit, in pausing a moment to express our gratitude to those to whom we owe it,—first to our founder, Johns Hopkins, for his munificence; and next to his trustees. Probably very few present realize how much time and thought the trustees spent on the building before a stone of the foundation was laid, and during its erection. No one but myself knows how often I have been put in good heart by the cheering words, "Well, Dr. Martin, let us get it right when we are about it." In this connection I cannot refrain from saying, that, while we owe all so much, we owe a special debt of gratitude to Mr. J. Hall Pleasants, the chairman of the building committee. Throughout the summer there was hardly a morning on which he did not visit the building; and that not merely for a glance, but far more often to spend an hour or two hours in or about it, and make sure that all was going right.

The material result of this liberality, forethought, and supervision is that stately building on the top of the hill. Handsome though not ostentatious, comfortable but not luxurious, pleasant to work in without unnecessary finery, it stands there, for its purpose unrivalled in the United States, and not surpassed in the world.

Substantial, solid, well thought out, suited to its ends, and with no frippery about it, it is now for the biologists to see that their work agrees in character with the building.

There are many here to-night, who, not being biologists, may desire to know what such laboratories are for, and why there is any need of them. I shall perhaps best begin my attempt to answer these questions by stating briefly what our own laboratory is.

It is a building constructed primarily to afford facilities for instruction and research in physiology; and secondarily, similar opportunities in allied sciences, as comparative anatomy and botany, some training in which is essential (and the more the better) to everyone who would attain any real knowledge of physiology. As so many distinct branches of biological science are pursued in it, we call it in general the biological laboratory; but it is a biological laboratory deliberately planned that physiology in it shall be queen, and the rest her handmaids. If, therefore, you visit the building prepared to see a great zoölogical museum or an extensive herbarium, you will be disappointed. I do not underrate, and no one connected with this university can,—having in mind the brilliant anatomical researches of Dr. Brooks and others, made among us,—the claims of morphology; and in time I trust we may see a sister building specially designed for study of the structure, forms, and development of plants and animals. But one or the other had to be first chosen unless we were to do two things imperfectly instead of one well, and there were strong reasons for selecting physiology. In the first place, I think even the morphologists will admit that hitherto, and especially in the United States, they have had rather more than their fair share; numerous museums and laboratories have been built for their use; while physiology, if she got anything, has been usually allotted some out-of-the-way room in an entirely unsuitable building, if no one else wanted it; and been very glad to get even that. A second and still stronger reason is, that as medicine is slowly passing out of the regions of empiricism and rule-of-thumb treatment, or mal-treatment, it has become evident that sound physiology is its foundation; and this university will at no distant day have a medical school connected with it.

As you walk presently through the rooms of the new building, and see the many instruments of precision for teaching and research — the batteries, galvanometers, induction-coils, and spectroscopes; the balances, reagents, and other appliances of a chemical laboratory; the microscope for every student; the library of biological books and journals; the photographic appliances; the workshop for the construction and repair of instruments—when you see these things, it may interest you to recall that sixty years ago there was not a single public physiological laboratory in the world; nor was there then, even in any medical school, a special professor of physiology. So late as 1856 Johannes Müller taught in Berlin human anatomy, comparative anatomy, pathological anatomy, physiology, and embryology.

DuBois-Reymond, now himself professor in Berlin, has graphically described the difficulties of the earnest student of physiology, when he attended Müller's lectures in 1840.[*]

> "We were shown a few freshly prepared microscopic specimens (the art of putting up permanent preparations being still unknown), and the circulation of the blood in the frog's web." So much for the histological side.
>
> "We were also shown the experiment of filtering frog's blood to get a colorless clot, an experiment on the roots of the spinal nerves, some reflex movements in a frog, and that opium-poisoning was not conducted along the nerves. There were some better experiments on the physiology of voice,—a subject on which Müller had recently been working; and there was finally a demonstration of the effect upon respiration of dividing the pneumogastric nerves."

In all, you see six experiments or sets of experiments, in the whole course, in addition to the exhibition of some microscope slides; and all these mere demonstrations. It was hardly thought of that a student should use a microscope, or make an experiment, himself. If he desired to do so, the difficulties in his way were such as but few overcame.

> "He must experiment in his own lodgings, where on account of his frogs he usually got into trouble with the landlady, and where many researches were impossible—there were no trained assistants to guide him—no public physiological library—no collection of apparatus. We had to roll our own coils, solder our own galvanic elements, make even our own rubber tubing, for at that time it was not an article of commerce. We sawed, planed, and drilled—we filed, turned, and polished. If through the kindness of a teacher a piece of apparatus was lent to us, how we made the most of it—how we studied its idiosyncrasies—above all, how we kept it clean."

Of course certain men, the men who were born to become physiologists, and not mere students of physiology, surmounted these difficulties. One has only to recall the names of DuBois-Reymond himself, and of his contemporaries, Brücke, Helmholtz, Ludwig, Vierordt, Donders, and Claude Bernard, to realize that fact: and undoubtedly there was a good side to it all. Triflers were eliminated; and the class of individuals was unknown who sometimes turn up at modern laboratories (and judging from a good deal of current physiological literature, sometimes get admitted to them) with a burning desire to undertake forthwith a complicated research, though they hardly know an ordinary physiological instrument when they see it; much less know how to handle it. But they cannot wait; they must begin the next morning, believing, I presume, that laboratories are stocked with automatic apparatus,—some sort of physiological sausage-machines, in which you put an animal at one end, turn the handle, and get out a valuable discovery at the other.

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[*] Emil DuBois-Reymond. *Der physiologische Unterricht, sonst und jetzt.* Berlin, 1878. The quotations from this pamphlet, while giving, I trust, a true idea of the substance of DuBois-Reymond's statements, have been curtailed, and are not to be regarded as literal full translations of the original.—H. N. M.

With one exception, Berlin was not in 1840 worse off than other German universities so far as facilities for physiological study were concerned, and certainly better off than any university in England or the United States. The exception was in Breslau, where the celebrated Purkinje, single-handed, had founded a physiological institute. It has usually been supposed that in this he followed the example of Liebig, who founded at Giessen the first public chemical laboratory; but this, *pace* the chemists, can hardly have been the case. It is to Purkinje that the honor belongs of founding the first public laboratory. Liebig undoubtedly conceived the plan when working in Paris in Gay Lussac's private laboratory, but it was not until 1826 that he began to put it into execution; and at that date Purkinje had already, largely at his own cost, started a physiological laboratory at Breslau, open to students,—on a small scale, it is true, but still the germ of all those great laboratories of physics, chemistry, and biology, which are now found in every civilized country, and to which, more than to anything else, modern science owes its rapid progress. Of these there must be at least forty now organized for physiological work; and almost every year sees an increase in their number. How has this come about in the fifty odd years which have passed since the opening of Purkinje's poorly-equipped and little known workrooms?

First, because of the improvement in philosophy which took place when men began to break loose from the trammels of mediaeval metaphysics, and to realize that a process is not explained by the arbitrary assumption of some hypothetical cause invented to account for it. So long as the phenomena exhibited by living things were regarded, not as manifestations of the properties of the kind of matter of which they were composed, but as exhibitions of the activity of an extrinsic independent entity,—a *pneuma*, *anima*, *vital spirit*, or *vital principle* which had temporarily taken up its residence in the body of an animal, but had no more essential connection with that body than a tenant with the house in which he lives,—there was no need for physiological laboratories. Dissection of the dead body might, indeed, be interesting as making known the sort of machine through which the vital force worked,—just as some people find it amusing to visit the former abode of a great author, and see his library and writing-table and inkstand; and there might be discussions as to the locality of the body in which this vital force resided; to carry out our simile, as to what was its favorite armchair. Various guessers placed it in the heart, the lungs, the blood, the brain, and so forth. Paracelsus, with more show of reason, located it in close connection with the stomach, on the top of which he supposed there was seated a chief vital spirit, Archaeus, who superintended digestion. It is mainly to Descartes,* who lived in the earlier half of the seventeenth century, that physiology owes the impulse which set it free from such will-o'-the-wisps. Putting aside all consciousness as the function of the soul, he maintained that all other vital phenomena were due to properties of the material of which the body is composed; and that death was not due to any defect of the soul, but to some alteration or degeneration in some part or parts of the body.

The influence of Descartes, and, in the same half-century, the demonstration of the circulation of the blood by Harvey, gave a great impulse to experimental physiology. Both Harvey and Descartes, however, still believed in a special locally placed vital spirit or *force* which animated the whole bodily frame; as the engine in a great factory moves all the machinery in it. What a muscle did, or a gland did, depended on the structure and properties of the muscle or gland; but the work-power was derived from a force outside those organs,—on vital spirits supplied from the brain along the nerves, or carried to every part in the blood. As the pattern of a carpet depends on the structure and arrangement of the loom,—which loom, however, is worked by a distant steam-engine,—so the results of muscular or glandular activity were believed to be determined by the structure of muscle and gland; but the moving-force to come from some other part of the body.

The next important advance was made by Haller, about the middle of the eighteenth century. He demonstrated that the contracting-power of a muscle did not depend on vital spirits carried to it by nerve or blood, but on properties of the muscle itself. Others had guessed, Haller proved, that the body of one of the higher animals is not a collection of machines worked by a central motor, but a collection of machines each of which is in itself both steam-engine and loom; leaving aside, of course, certain of the purely mechanical supporting and protecting apparatuses of the skeleton. This was the death-blow of the 'vital force' doctrine. Extensions of Haller's method showed that it was possible to destroy the brain and spinal cord of an animal, and separate its muscles, its heart, its nerves, its glands, and yet keep all these isolated organs working as in normal life for many hours. Henceforth the *life* of an animal could not be regarded as an entity residing in one region of the body, from which it animated the rest; the word gradually became a mere convenient phrase for expressing the totality or *resultant* of the actions of the individual organs. Physiologists began to see that they had nothing to do with hunting out a vital force, or with essences or absolutes; that their business was to study the phenomena exhibited by living things, and leave the noumena, if there were such, to amuse metaphysicians. Physiology became more and more a study of the mechanics, physics, and chemistry of living organisms and parts of organisms.

Progress at first was necessarily very slow; physics and chemistry, as we now know them, did not exist. Galvanism was not discovered, osmosis was unknown, the conservation of energy was undreamed of; modern chemistry did not take its rise until the discovery of oxygen by Priestley, and the extension and application of that discovery by Lavoisier towards the close of the last century. Physiology had to wait then, as now, for its advance upon the development of the sciences dealing with simpler forms of matter than those found in living things. But little by little, step after step, so many once mysterious vital processes have been explained as but special illustrations of general physical and chemical laws, that now the physiologist scans each advance in chemistry or physics in full confidence that it will enable him to add others to the phenomena of living bodies, which are in ultimate analysis not peculiar or 'vital,' but simply physico-chemical. Apart from the phenomena of mind, whose mysterious connection with forms of matter he can never hope to explain, if a physiologist were to-day asked what is the object of his science, he would answer, "not the discovery or the localization of a vital force, but the study of the quantity of oxidizable food taken into the stomach, and the quantity of oxygen absorbed in the lungs; the calculation of the energy or force liberated by the combination of the food and oxygen; observation of the way in which that force has been expended, the means by which its distribution has been influenced, and the form in which the unused matter, if any, has been stored."

Once it was recognized that the majority of physiological problems were problems admitting of experimental investigation, the necessity for special collections of apparatus suitable for experiment on living plants and animals, and for affording students an opportunity to study the play of forces in living organisms, had not long to wait for recognition. Physiological laboratories were organized: at first in such rooms as could be spared in buildings constructed for other purposes; later, in structures built for this special end. The first laboratory specially erected for physiological work was built for Vierordt, in Tübingen, less than twenty years ago. So far as I know, our own is the first such building in the United States.

There is still another reason which has combined with the recognition of the independence of physiology as a science to make the modern laboratory, open to all properly prepared students, a possibility; and physiology owes it to this country. I do not forget how Brown-Sequard in Philadelphia clinched and completed Bernard's great discovery of the vaso-motor nerves; nor the researches of Weir Mitchell on the functions of nerve-centres, and the action of snake-poisons; nor, in later years, the researches of Wood on the physiology of fever; and, on various subjects, of Bowditch, Arnold, Flint, Minot, Sewall, Ott, Chittenden, Prudden, Keyt, Sedgwick, and others. But speaking with all the diffidence which one, who, at least by birth, is a foreigner, must feel in expressing such an opinion, I say, that considering the accumulated wealth of this country, the energy which throbs throughout it, and the number of its medical schools, it has not done its fair share in advancing physiological knowledge; but for one thing, which makes the world its debtor. I mean the discovery of anaesthetics. When Morton in 1846, demonstrated in the Massachusetts General Hospital that the inhalation of ether could produce complete insensibility to pain, he laid the foundation-stone of our laboratory, and of many others. No doubt the men whose instincts led them to physiological research, and who realized that by the infliction of temporary pain on a few of the lower animals they were discovering truths which would lead to alleviation of suffering and prolongation of life, not only in countless generations of such animals themselves, but in men and women to the end of time, would have tried to do their work in any case. But those who can steel their hearts to inflict present pain for future gain are few in number. The discovery of anaesthetics has not only led to ten physiological experimenters for each one who would have worked without them, but by making it possible to introduce into the regular course of physiological teaching demonstrations and experiments on living animals, without shocking the moral sense of students or of the community at large, has contributed incalculably to the progress of physiology.

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* See Huxley: *The connection of the biological sciences with medicine* (*The Lancet*, Aug. 13, 1881).

On the occasion of the opening of the old laboratory I used these words: [*] —

> "Physiology is concerned with the phenomena going on in living things, and vital phenomena cannot be observed in dead bodies; and from what I have said you will have gathered that I intend to employ vivisections in teaching. I want, however, to say, once for all, that here, for teaching purposes, no painful experiment will be performed. Fortunately the vast majority of physiological experiments can nowadays be performed without the infliction of pain; either by the administration of some of the many anaesthetics known, or by previous removal of parts of the central nervous system; and such experiments only will be used here for teaching. With regard to physiological research, the case is different. Happily here, too, the number of necessarily painful experiments is very small indeed; but in any case where the furtherance of physiological knowledge is at stake—where the progress of that science is concerned, on which all medicine is based, so far as it is not a mere empiricism—I cannot doubt that we have a right to inflict suffering upon the lower animals, always provided that it be reduced to the minimum possible, and that none but competent persons be allowed to undertake such experiments."

Those words were a declaration of principle, and a pledge given to this community, in which I was about to commence my work. That the work has been carried on for seven years among you, without a murmur of objection reaching my ears, is sufficient proof that Baltimore assents to the principle; and, gratifying as the building of our new laboratory is to me from many points of view, there is none so grateful as its witness, that, in the opinion of our trustees and of my fellow-citizens, I have carried out my pledge. There has been no hole-and-corner secrecy about the matter: the students in the laboratory have been no clique living isolated in a college building; but either your own sons, or boarders scattered among dozens of families in this city; and no room in the laboratory has ever been closed to any student: what we have done has been open to all who cared to know. On this occasion, when we make a fresh start, I desire to re-assert the principle, and repeat the pledge.

We have seen that Haller laid the foundation of our knowledge that the body of one of the higher animals is essentially an aggregation of many organs, each having a sort of life of its own, and in health co-operating harmoniously with others for the common good. In the early part of this century, before scientific thought had freed itself from mediaeval guidance, this doctrine sometimes took fantastic forms. For example, a school arose which taught that each organ represented some one of the lower animals. DuBois-Reymond relates that in 1838 he took down these notes at the lectures of the professor of anthropology: —

> "Each organ of the human body answers to a definite animal, is an animal. For example, the freely movable, moist, and slippery tongue is a cuttlefish. The bone of the tongue is attached to no other bone in the skeleton; the cuttlefish has only one bone, and consequently this bone is attached to no other. It follows that the tongue is a cuttlefish."

However, while Professor Steffens and his fellow transcendentalists were theorizing about organs, others were at work studying their structure; and a great step forward was made in the first year of our century by the publication of Bichât's 'Anatomie générale.' Bichât showed that the organs of the body were not the ultimate living units, but were made up of a number of different interwoven textures, or *tissues*, each having vital properties of its own. This discovery paved the way for Schwann and Schleiden, who laid the foundation of the cell-theory; and showed, that, in fundamental structure, animals and plants are alike, the tissues of each being essentially made up of aggregates of more or less modified microscopic living units called *cells*. Our own generation has seen this doctrine completed by the demonstration that the essential constituent of the cell is a peculiar form of matter named protoplasm, and that all the essential phenomena of life can be manifested by microscopic bits of this material; that they can move, feed, assimilate, grow, and multiply; and still further, that, wherever we find any characteristic vital activity, we find some variety of protoplasm. Physiology thus has become reduced in general terms to a study of the faculties of protoplasm; and morphology to a study of the forms which units or aggregates of units of protoplasm, or their products, may assume. The isolation of botany, zoölogy, and physiology, which was threatened through increased division of labor, due to increase of knowledge necessitating a limitation of special study to some one field of biology, was averted; and the reason was given for that principle which we have always insisted upon here,—that beginners shall be taught the broad general laws of living matter before they are permitted to engage in the special study of one department of biology.

If I be asked, what have biological science in general and physiology in particular done for mankind to justify the time and money spent on them during the past fifty years, I admit it to be a perfectly fair question; fortunately it is one very easy to answer. Leaving aside the fruitful practical applications of biological knowledge to agriculture and sanitation, I will confine myself to immediate applications of the biological sciences to the advance of the theory, and, as a consequence, of the art of medicine.

So long as the life of a man was believed to be an external something distinct from his body, but residing in it for a while, diseases were naturally regarded as similar extrinsic essences or entities, which invaded the body from without, and fought the 'vital force.' The business of the physician was to drive out the invader without expelling the vital spirits along with it,—an unfortunate result, which only too often happened. To the physicians of the sixteenth century a fever was some mysterious extraneous thing, to be bled, or sweated, or starved out of the body, much as the medicine-men of savages try to scare it off by beating tomtoms around the patient. Once life was recognized as the sum total of the properties of the organs composing the body such a theory of disease become untenable, and the basis of modern pathology was laid. Disease was no longer a spiritual indivisible essence, but the result of change in the structure of some one or more of the material constituents of the body, leading to abnormal action. The object of the physician became, not to expel an imaginary immaterial enemy, but to restore the altered constituent to its normal condition.

The next great debt which medicine owes to biology is the establishment of the cell-doctrine,—of the fact that the body of each one of us is made up of millions of little living units, each with its own properties, and each in health doing its own business in a certain way under certain conditions; and no one cell being more the seat of life than any other. The activities of certain cells may, indeed, be more fundamentally important to the maintenance of the general life of the aggregate than that of others; but the cells, which, by position or function, are more essential than the rest, are, in final analysis, no more alive than they. Before the acceptance of the cell-doctrine pathologists were practically divided into two camps,—those who believed that all disease was primarily due to changes in the nervous system, and those who ascribed it to alteration of the blood. With the publication of Virchow's 'Cellular pathology' all this was changed. Physicians recognized that the blood and nerves might at the outset be all right, and yet disease originate from abnormal growth or action of the cells of various organs. This new pathology, like the older, was for a time carried to excess. We now know that there may be general diseases primarily due to changes in the nervous system, which binds into a solidarity the organs of the body; or of the blood, which nourishes all: but we have also gained the knowledge that very many, if not the majority, of diseases have a local origin, due to local causes, which must be discovered if the disease is to be successfully combated. An engineer, if he find his machinery running imperfectly, may endeavor to overcome this by building a bigger fire in his furnace, and loading the safety-valve. In other words, he may attribute the defect to general causes; and in so far he would resemble the old pathologists. But the skilled engineer would do something different. If he found his machinery going badly, he would not jump forthwith to the conclusion that it was the fault of the furnace, but would examine every bearing and pivot in his machinery, and, only when he found these all in good working-order, begin to think the defect lay in the furnace or boiler; and in that he would resemble the modern physician instructed in the cell-doctrine.

A third contribution of biology to medical science is the germ-theory as to the causation of an important group of diseases. To it we owe already antiseptic surgery; and we are all now holding our breath in the fervent expectation that in the near future, by its light, we may be able to fight scarlet-fever, diphtheria, and phthisis, not in the bodies of those we love, but in the breeding-places, in dirt and darkness, of certain microscopic plants.

From one point of view the germ-theory may seem a return to the idea that diseases are external entities which attack the body; but note the difference between this form of the doctrine and the ancient! We are no longer dealing with immaterial, intangible, hypothetic *somethings*; the modern practitioner says, "Well, show me the bacteria, and then prove that they cause the disease: until you can do that, do not bother me about them."

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[*] *Pop. sc. monthly*, December, 1876.

It is worth while, in passing, to note that these three great advances in medical thought were brought about by researches made without any reference to medicine. Haller's purely physiological research into the properties of muscles laid the foundation of a rational conception of disease. The researches of Schwann on the microscopic structure of plants, and since then researches of others on the structure of the lowest animals, led to the cellular pathology. Antiseptic surgery is based on experiments carried out for the sole purpose of investigating the question as to spontaneous generation. My friend Dr. Billings has described "the languid scientific swell, who thinks it bad style to be practical, and who makes it a point to refrain from any investigations which lead to useful results, lest he might be confounded with mere practical men." Well, I am sorry for the swell! because, for the life of me, I cannot see how he can make any investigations at all. The members of his class must be so few in number that we need not waste much grief on them. I never have met with an investigator who would not be rejoiced to find any truth discovered by him put to practical use; and I feel sure that in this day and generation the chief danger is that disproportionate attention will be devoted to practical applications of discoveries already made, to the exclusion of the search for new truth. So far as physiology is concerned, it has done far more for practical medicine since it began its own independent career, than when it was a mere branch of the medical curriculum. All the history of the physical sciences shows that each of them has contributed to the happiness and welfare of mankind in proportion as it has been pursued by its own methods, for its own ends, by its own disciples. As regards physiology, this is strikingly illustrated by a comparison of the value to medicine of the graduation theses of Parisian and German medical students. A candidate for the doctorate of medicine in France or Germany, as in many schools here, must present a graduation thesis on some subject connected with his studies. Every year a certain number select a physiological topic. The French student usually picks out some problem which appears to have a direct bearing on the diagnosis or treatment of disease, while the German very often takes up some physiological matter which on the surface has nothing to do with medicine. Now, any one who will carefully compare for a series of years the graduation theses in physiology of German and French candidates, will discover that even the special practical art of medicine itself is to-day far more indebted to the purely scientific researches of the German students than to those of the French, undertaken with a specific practical end in view. Situated as we shall be here, in close relation to a medical school, and yet not a part of it, I believe we shall be under the best possible conditions for work. Not under too direct pressure from the professional staff and students on the one hand, on the other we shall be kept informed and on the alert as to problems in medicine capable of solution by physiological methods.

I must find time to say a few words as to the connection of physiology with pathology and therapeutics. The business of the physiologist being to gain a thorough knowledge of the properties and functions of every tissue and organ of the body, he has always had for his own purposes to place these tissues under abnormal conditions. To know what a muscle or a gland is, he has to study it not merely in its normal condition, but when heated or cooled, supplied with oxygen or deprived of it, inflamed, or starved; and see how it behaves under the influence of curari, atropine, and other drugs. From the very start of physiological laboratories a good deal of work done in them has necessarily been experimental pathology and experimental therapeutics. I suppose to-day that at least half of the work published from physiological laboratories might be classed under one or other of these heads. And what has been the fruit? I can here refer only to one or two examples. It it not too much to say, that, though inflammation is the commonest and one of the longest studied pathological states, we really knew nothing about it before the experimental researches of Lister, Virchow, and Cohnheim; and that all we really know as to the nature of fever is built on the similar researches of Bernard, Haidenhain, Wood, and others. As to therapeutics, so far as giving doses of medicine is concerned, it, still in its very infancy, had its birth as an exact science in physiological laboratories. Every modern text-book on the subject gives an account of the physiological action of each drug. What the future may have in store for us by pursuit of such inquiries it is hard to limit. The work of Bernard,—showing that in curari we had a drug that would pick out of the whole body, and act upon, one special set of tissues, the endings of the nerve-fibres in muscle,—and the results of subsequent exact experiments as to the precise action of many drugs upon individual organs or tissues, hold out before us a hope that, perhaps at no very distant day, the physician will know exactly, and in detail, what every drug he puts into his patient is going to do within him.

Pathology and therapeutics, while almost essential branches of physiological inquiry, have nevertheless their own special aims; and, now that the physiologists have proved that it is possible to study these subjects experimentally, special laboratories for their pursuit are being erected in Germany, France, and England. These laboratories are stocked with physiological instruments, and carry on their work by physiological methods. Those who guide them, and those who work in them, must be trained physiologists: if not, the whole business often degenerates into a mere slicing of tumors and putting up of pickled deformities: pathological anatomy is a very good and very important thing in itself, but it is not *pathology*. Looking at the vast field of pathological and therapeutic research open to us, and bearing in mind the certainty of the rich harvest for mankind which will reward those who work on it, I believe it one of my chief duties to prepare in sound physiological doctrine and a knowledge of the methods of experiment, students who will afterwards enter laboratories of experimental pathology and pharmacology immediately connected with a medical school.

If the relations of the biological sciences to medicine be such as I have endeavored to point out, what place should they occupy in the medical curriculum? That men fitted for research, and with opportunity to pursue it, should be trained to that end, is all well and good; but how about the ninety per cent who want simply to become good practitioners of medicine? What relation is this laboratory to hold to such men, who may come to it, intending afterwards to enter a medical school? As a part of their general college-training, affording that education of a gentleman which every physician should possess, it should give a sound knowledge of the general laws which govern living matter, without troubling students with the minutiae of systematic zoölogy or botany; it should enable them to learn how to dissect, and make them well acquainted with the anatomy of one of the higher animals; it should teach them how to use a microscope; and the technique of histology; and finally, by lectures, demonstrations, and experiment, make known to them the broad facts of physiology, the means by which those facts have been ascertained, and the basis on which they rest. The student so trained, while obtaining the mental culture which he would gain from the study of any other science, is especially equipped for the study of medicine. Taught in other parts of his general collegiate course to speak and write his own language correctly, having acquired a fair knowledge of mathematics and Latin, able to read at least French and German, having learned the elements of physics and chemistry, and in addition, having studied the structure and properties of the healthy body, he can, on entering the technical school, from the very first turn his attention to professional details. Knowing already the anatomy of a cat or a dog, he knows a great part of human anatomy, and need do little but acquaint himself with the surgical and medical anatomy of certain regions. Knowing normal histology, he can at once turn his attention to the microscopy of diseased tissues. Well instructed in physiology, he can devote himself to its practical applications in the diagnosis and treatment of disease. The demand for an improvement in medical education, which has been so loudly heard in England and this country for some years, is (the more I think of it, the more I feel assured) to be met, not, as has been the case in England, by putting more general science into the medical curriculum, but by confining that curriculum to purely professional training, and providing, as we have attempted to do here, non-technical courses for undergraduates, which, while forming part of a liberal education, also have a distinct relation to their future work. I regard it as the most important of my duties, to prepare students to enter medical schools in this city or elsewhere.

To advance our knowledge of the laws of life and health; to inquire into the phenomena and causes of disease; to train investigators in pathology, therapeutics, and sanitary science; to fit men to undertake the study of the art of medicine,—these are the main objects of our laboratory. I do not know that they can be better summed up than in the words of Descartes, which I would like to see engraved over its portal: "If there is any means of getting a medical theory based on infallible demonstrations, that is what I am now inquiring." (*Reprinted from Science, January* 18, 25, 1884).

CHESAPEAKE ZOÖLOGICAL LABORATORY.

Report of the Director for its first six years, 1878-83.

President of the Johns Hopkins University:

: In accordance with your request to prepare an outline or sum- of the work of the marine laboratory during the six years of its ice, I have the pleasure to submit in connection with the report sixth session, the following review of the history of the five ing years.

FIRST YEAR, (1878), AT FORT WOOL, VA.

1878, the Trustees of the Johns Hopkins University made a small riation, in order to enable a party of biological students to spend weeks at the seashore in the study of marine zoölogy under my on. Permission was given us by the Secretary of War, through fluence of Maj. Gen. Q. A. Gillmore, to occupy the vacant buildings rt Wool. Prof. Spencer F. Baird also exerted his influence with cretary of War in our behalf, and aided us in many other ways; ning us with dredging apparatus and with three small row boats, were used during the summer. The vacant buildings at Fort Wool not sufficient for our accommodation, as only one of them was in ntly good repair for use, and the watchman in charge of the fort, llen, readily consented to vacate for us all but one of the rooms in use, and much of the success of our first season was due to his t in our work.

ee students, who were not connected with the University, asked for sion to join our party, which, with these additions, consisted of ersons, and we remained at the fort for seven weeks.

scientific results of our season's work were printed in an illustrated e, the cost of publishing which was born by citizens of Baltimore, whom were Samuel M. Shoemaker, John W. Garrett, John W. , Enoch Pratt, P. R. Uhler, President Gilman, Professor Martin, hers.

ong these papers the most noteworthy were one on the "Develop- f Lingula" and one on the "Early Stages of Squilla." Both of apers were reprinted in foreign journals, and their contents have een incorporated in the best foreign text-books of zoölogy, such as "Zoölogie" and Balfour's "Comparative Embryology."

ND YEAR, (1879), AT CRISFIELD, MD., AND FORT WOOL, VA.

appropriation for the maintenance of the laboratory was continued Trustees of the University for the next year.

rder to present an opportunity for studying the oyster beds of the nd thus secure the coöperation of Maj. Ferguson, Assistant U. S. ommissioner, I determined to open the laboratory at Crisfield, a which is unfavorable in most other respects. The laboratory was ingly opened at Crisfield on the 25th of June in three of the barges Maryland Fish Commission.

ated in the preliminary announcement that the laboratory would ved to some more desirable locality farther down the Bay, about 0, but the transportation of the barges was attended with so expense that I was not able to move them to the second station, occupied them at Crisfield until August 8. During part of this Maj. Ferguson's steam yacht, the Lookout, which he had fitted up team dredging apparatus for the purpose, was with us, and rendered le help in dredging and collecting. Through Maj. Ferguson's ce we also had the use of a small steam launch which was detailed purpose from the U. S. Navy.

y in August the mosquitoes became so numerous as to render the uninhabitable, and we transferred our outfit to our old quarters at Vool, which had again been placed at our service by Maj. Gen. Gillmore, U. S. A., and where Mr. Allen again placed his private s at our service.

he beginning of this session, which lasted for eleven weeks, a cir- was issued by the University inviting other naturalists to avail lves of our facilities, upon the payment of a small fee, and some of ty of twelve were persons who came from other institutions.

Among the more important of the published results of this season's work were a paper on the Development of the Oyster, one on the Metamorphosis of Phornis, one on the Development of the Squid, and one on the Metamorphosis of Panopaeus.

THIRD, FOURTH, AND FIFTH YEARS, (1880–82), AT BEAUFORT, N. C.

The next year, the Trustees of the University voted to continue the laboratory for three years more, and they provided a liberal annual appropriation for the current expenses, and they also voted that the sum of $4,500 be appropriated for the purchase of outfit, &c. After an examination of all the available localities, the town of Beaufort, N. C., about four hundred miles south of Baltimore, was selected as the site for the laboratory, and as a vacant house, suitable for the accommodation of a small party, was found there, it was rented for three years, and as none of the $4,500 was needed for the erection of a building, most of it was used, by the permission of the Trustees, in the purchase of two boats, for collecting. One of these, a Herreshoff launch, twenty-seven feet long, and eight feet beam, was built for us in 1880, and the second, a sloop forty-seven feet long and fourteen feet beam, was purchased in the summer of 1883.

The natural advantages of Beaufort are very great, as the fauna is exceptionally rich and varied, abounding in forms which are of peculiar interest.

The configuration of our coast line is such that Cape Hatteras, the most projecting point south of New York, deflects the warm water of the Gulf Stream away from the coast, and thus forms an abrupt barrier between a cold northern coast and a warm southern one. The fauna north of this barrier passes gradually into that of Southern New England, while the fauna south of the barrier passes without any abrupt change into that of Florida, but the northern fauna is sharply separated by Cape Hatteras from the southern.

As the laboratory of the U. S. Fish Commission and Mr. Agassiz's laboratory at Newport afford opportunities for work upon the northern fauna, it seemed best for us to select a point south of Cape Hatteras in order to study the southern fauna with the same advantages, and as Beaufort is the only town near the Cape which can be reached without difficulty, it was chosen as the best place for the laboratory.

The situation of this town is exceptionally favorable for zoölogical work, for the surrounding waters present such a diversity of conditions that the fauna is unusually rich and varied.

Close to the town there are large sand bars, bare for miles at low tide, and abounding in animal life. From these we could collect an unfailing supply of Amphioxus, Renilla, Limulus, Balanoglossus, Sea Urchins, and a great variety of Molluscs and Crustacea.

The mud flats furnished us with another fauna, and yielded a great variety of Annelids, a new set of species of Crustacea and Molluscs, Gephyreans, Echinoderms, and Polyps. The large salt marshes gave us a third fauna, and a short distance inland large swamps of brackish and fresh water furnished still other conditions of life.

As the town is situated at the point where Gore Sound connects Pamlico Sound with Bogue Sound, we were within easy reach of a continuous sheet of landlocked salt water more than a hundred miles long, and these Sounds furnished still another collecting and dredging ground, abounding in Corals, Gorgonias, Ascidians, Star Fish, Sea Urchins, and a new set of Molluscs and Crustacea.

As most of the shores are flat and sandy those animals which live upon a sandy bottom are much more abundant than those which attach themselves to solid bodies, but the stone breakwaters at Fort Macon, the wharves at Beaufort and Morehead City, and the large oyster beds which are found in the Sounds furnish a proper habitat for many fixed animals, and yielded us a rich supply of Hydroids, Corals, Ascidians, Sea Anemones, Sponges, Cirripeds, &c. The ocean beach within a short distance of the town furnished still another fauna, and a sail of three miles from the laboratory carried us to a good locality for ocean dredging.

The greatest advantage of the locality is the richness of its pelagic fauna. There are very few points upon land which are so situated that the surface animals of mid-ocean can be procured in abundance for laboratory work, and as careful work is very difficult on shipboard, a laboratory which can be supplied with a good number of living pelagic animals presents opportunities for work in an extremely interesting and almost new field.

The Gulf Stream is constantly sweeping these animals northwards along the North Carolina coast, and as the tide sets in through Beaufort Inlet into the Sounds the floating animals are carried with it. Such oceanic animals as Physalia and Porpita were frequently thrown, uninjured and in perfect health, upon the beach within twenty feet of the laboratory, and during the season we found nearly all the Siphonophora which are known to occur upon our Atlantic coast.

With all these advantages we enjoyed a mild and uniform climate which enabled us to work in perfect comfort during the hottest months of summer.

The zoölogical resources of Beaufort have not escaped the attention of American naturalists, and there are few places upon our coast, outside of New England, where more zoölogical work has been done. In 1860, Drs. Stimpson and Gill spent a season in dredging and collecting in the vicinity of Beaufort, Cape Lookout, and Cape Hatteras, and an account of their work was published in the *American Journal of Science.* Dr. Coues, who was stationed at Fort Macon during the war, occupied himself for two years in collecting the animals which are found here, and he published a series of papers on the "Natural History of Fort Macon and Vicinity" in the *Proceedings of the Academy of Natural Sciences of Philadelphia.*

These papers, which were continued by Dr. Yarrow, contain copious and valuable notes on the habits and distribution of the animals which were observed, and we found them a great help to us. These two naturalists found four hundred and eighty species of animals in the vicinity of Beaufort. Of these four hundred and eighty, two hundred and ninety-eight are vertebrates, and one hundred and eighty-two are invertebrates. Of the vertebrates twenty-four are mammals, one hundred and thirty-three are birds, twenty seven are reptiles, six batrachians, ninety-seven fishes and eleven selachians. Of the invertebrates one hundred and forty-seven are molluscs, twenty-one are crustaceans. The list of vertebrates is very nearly complete, and we made few additions to it, but the list of invertebrates is obviously very imperfect, and, although we made no attempt to tabulate the species which we observed, there would be no difficulty in enlarging the list twenty or thirty fold.

Among other naturalists who have spent more or less time at Beaufort, I may mention Professor L. Agassiz, Professor E. S. Morse, Dr. A. S. Packard, Professor Webster, and Professor D. S. Jordan. Professor Morse procured most of the material for his well known paper on the Systematic Position of the Brachiopoda on the sand bars in Beaufort Inlet.

During the years 1880, 1881, and 1882, the laboratory at Beaufort was occupied by our party for sixty-four weeks in all, and twenty-two persons availed themselves of its facilities for research.

Among the published results of our investigations, lists of which have been printed in your annual reports, two papers deserve especial mention.

One of these, a monograph on the Development of Lucifer, has been printed with eleven quarto plates in the *Philosophical Transactions of the Royal Society,* while another on the Anatomy and Development of Renilla, with fourteen plates, is now in the press of the Royal Society, and is to appear soon.

Sixth Year, (1883), at Hampton, Va.

In the spring of 1883, the Trustees of the University voted to continue the annual appropriation for the current expenses of the laboratory for two years more.

My duties this summer as a Commissioner, appointed by the Governor of Maryland to examine the condition of the oyster beds of the State, compelled me to spend the season in the Chesapeake Bay, and the removal of the laboratory from Beaufort, N. C., where it had been for three years, was therefore decided upon.

The absence of buildings for the accommodation of our party at any suitable point upon the Bay except at Fort Wool and Hampton, restricted us to these two places in our selection of a laboratory. Application was made to the Secretary of War, through Maj. Gen. Q. A. Gillmore, for permission to occupy the buildings at Fort Wool, and this permission was granted; but upon visiting the fort I found the buildings so ruinous, and the wharf so injured by storms, that I decided that it would not be prudent for our party to spend the season there, and as Gen. S. C. Armstrong, the President of the Hampton Normal and Industrial Institute, kindly consented to permit our party to use an unoccupied building which had just been erected by the Institute as a machine shop, the second floor and attic were rented by the University for the season, and were occupied by the members of our party from May 1 to October 1.

The second floor room, which is large and well lighted, furnished ample laboratory accommodations, and the attic was used as lodgings.

The location was found to be a bad one, as the collecting grounds were distant and far apart, and the fauna was not rich, but researches were carried on upon the following subjects, among others: the anatomy and development of barnacles, the anatomy and development of crabs, the histology of Eudendrium, the anatomy and development of Balanoglossus, the development of the oyster, the anatomy of Lingula, the protozoea stage of crabs, the development of Annelids, the anatomy and development of Chrysaora, the origin of the eggs of hybrids and tunicates, the function of the semi-circular canals of sharks, and the general zoölogy of the Hydro-Medusae. Most of my own time for the last year has been given to the study of the oyster industry of Maryland, and my results will be stated in the report of the Oyster Commission, which is now in press.

Propagation of the Oyster.

During the past year experiments which have been carried on in France and in this country have resulted in the practical application of the methods of artificial oyster propagation, which were discovered at the laboratory five years ago, and the great economic importance of the subject will justify a short review of the history of these experiments.

Previously to 1879 our knowledge of the breeding habits of the oyster was entirely based upon the study of the oysters of northern Europe, and nothing whatever was known of the life history of the American oyster, as our writers had accepted without question the statements of foreign authorities. The oyster of northern Europe is hermaphrodite, and as the eggs are hatched inside the shell of the parent, and the young are thus carried and protected until they are ready to fasten themselves, good authorities had stated that it is not possible to rear oysters artificially.

In 1879, I found that the sexes are separate in the American oyster, and that the unfertilized eggs are thrown out in immense numbers into the water, where they are fertilized and develop without the need for any protection from their parents. I also showed that it is possible to fertilize the eggs artificially, and to rear the young oysters until long after they have acquired their shells, although I did not succeed in keeping them alive until they became attached. These experiments showed the perfect practicability of rearing oysters in unlimited numbers, as soon as the practical difficulties should be overcome.

A full account of my experiments and of the methods employed was published with figures of the early stages of the development of the oyster, in the first volume of the *Studies from the Biological Laboratory.*

While I was engaged in these experiments, Lieutenant Winslow, U. S. N., was engaged in surveying the oyster beds near the laboratory, which he visited in order to learn my methods. The next year, while stationed at Cadiz, Spain, he repeated the experiments with Portuguese oysters, and found that their breeding habits are exactly like those of the American species; that the sexes are separate; that the unfertilized eggs are thrown out into the water, and that the young can be reared from artificially fertilized eggs.

An account of his experiments was read before the Maryland Academy of Sciences in November, 1880, and it was afterwards published in the *American Naturalist.*

The next step which has resulted in the solution of the practical difficulties, and the rearing of oysters of economic value from artificially impregnated eggs, is due to experiments which were carried on by M. Bouchen-Brandely, under the auspices of the French Government.

In a paper, entitled "Rapport relatif à la génération et à la fécondation artificielle des huitres, adressé au ministre de la marine et des colonies par M. Bouchen-Brandely, secrétaire du Collège de France," and published in

December, 1882, in the *Journal officiel de la République Française*, this author states that he was encouraged by the experiments which Brooks, of the Johns Hopkins University of Baltimore, had made upon *Ostrea virginica*, to attempt similar experiments with the Portuguese oyster, *Ostrea angulata*. He was ignorant of Winslow's experiments with this oyster, but after two years of experiments, he succeeded in independently establishing the fact that the sexes of the Portuguese oyster are separate; that the eggs are thrown out into the water; that the young are independent of parental protection, and that they can be reared from artificially fertilized eggs.

The methods by which he succeeded in rearing these young oysters are described in his report as follows. Two oyster planting ponds, separated from each other by a straight massive wall of earth, and having an area of about 100 metres each, and an average depth of about 1 metre, were placed in communication by means of a pipe which was closed at each end by a sponge, to filter sediment from the water and to guard against the accidental introduction of spat. The outlet from the ponds was guarded by a dam of fine sand confined between boards, and thus allowing the water to escape, but retaining the swimming embryos. Artificially impregnated eggs were then poured into the lower pond in great numbers during the latter part of June and the month of July. The pond was furnished with tiles for the attachment of the spat, and on July 24th each of these tiles was found to have, attached to its surface, twenty or thirty young oysters, about two-fifths of an inch in diameter. Finally, during the early part of October he states that he had the honor of presenting to the minister of the marine a tile, upon which two thousand young oysters could be counted, measuring from two-fifths to four-fifths of an inch in diameter.

This interesting paper, which has been translated into English by J. A. Ryder, and published in the *Bulletin of the U. S. Fish Commission* for April 19, 1883, shows the practicability of the economic application of the more purely scientific experiments which were carried on at our laboratory in 1879. The author acknowledges that he was incited by these experiments, and our own share in the work is therefore exactly what we should wish: the discovery of a new scientific truth, which has, in the hands of practical economists, contributed to the welfare of mankind.

Mr. John A. Ryder has this summer repeated these experiments in Maryland, and has shown that they are as successful here as they are in France. An account of his apparatus and of the results obtained has been published in the *Bulletin of the U. S. Fish Commission* for September 6, 1883, under the title "Rearing Oysters from Artificially Fertilized Eggs, together with notes on Pond Culture, &c.," by John A. Ryder.

Summary.

During the six years of its existence, work has been carried on at the laboratory for one hundred and five weeks in all. It was attended by nine persons in 1878; by twelve in 1879; by six in 1880; by twelve in 1881; by eight in 1882; and by sixteen in 1883, thus making the total attendance sixty three. The number of persons who have used the laboratory is only forty however, as many of them have spent two or three seasons there. One-half of the attendants were members of the Johns Hopkins University, and the rest were then or now connected with the Smithsonian Institution; the United States Fish Commission; the Academy of Natural Sciences, Philadelphia; University of Cambridge (St. John's College), England; the Ontario Agricultural College, Canada; or with the American colleges and schools indicated in the subjoined roll.

The scientific papers which have been published by our party, based wholly or in part upon the work done at the laboratory, include fifty-five titles, and they have been printed in the following journals: *Studies from the Biological Laboratory; Johns Hopkins University Circulars; American Naturalist; American Journal of Science; Memoirs of the Boston Society of Natural History; Zoölogischer Anzeiger; London Quarterly Journal of Microscopical Science; Proceedings and Philosophical Transactions of the Royal Society*, London. Many of the papers have been reprinted, or summarized in foreign journals, but translations and summaries are not included in the enumeration given above.

A medal of the first class of the Société d'Acclimatation of Paris and one of the Walker Prizes of the Boston Society of Natural History have been awarded to members of our party for work which was done at the laboratory.

Within the last year Professor Mitsukuri, a naturalist who received his training in zoölogical research at our marine laboratory, has organized a similar laboratory on the coast of Japan, as a branch of the Government University of Tokio.

Yours respectfully,
W. K. BROOKS,
Director Chesapeake Zoölogical Laboratory.

Baltimore, *January*, 1884.

Roll of the Chesapeake Zoölogical Laboratory, 1878–83.

Director.

W. K. Brooks, Ph. D.

Members.

J. E. Armstrong, *Assistant in Natural History, Illinois Industrial University.* (*1881.*)
B. W. Barton, M. D., *Baltimore.* (*1879.*)
W. Bateson, *St. Johns College, University of Cambridge, England.* (*1882.*)
Emil Bessels, M. D., *Smithsonian Institution.* (*1879.*)
E. A. Birge, *Professor of Zoölogy, University of Wisconsin.* (*1879.*)
S. F. Clarke, Ph. D., *Professor of Natural History, Williams College.* (*1879, '81.*)
Buel P. Colton, A. B., *Teacher, Natural Science, Princeton (Ill.) High School.* (*1881*)
H. W. Conn, A. M., *Johns Hopkins University.* (*1882, '83.*)
Charles Earle, *New York.* (*1883.*)
H. C. Evarts, M. D., *Philadelphia.* (*1879, '80.*)
H. Garman, *Assistant, Illinois State Laboratory of Natural History.* (*1883.*)
O. P. Jenkins, A. M., *Johns Hopkins University.* (*1883.*)
J. W. King, *Professor of Natural Science, Wisconsin State Normal School.* (*1880.*)
F. S. Lee, A. M., *Johns Hopkins University.* (*1883.*)
K. Mitsukuri, Ph. D., *Professor of Zoölogy, University of Tokio, Japan.* (*1879, '80.*)
J. Playfair McMurrich, *Assistant in Biology, University of Toronto.* (*1881, '83.*)
T. W. Mills, M. D., *Montreal, Quebec.* (*1883.*)
H. F. Nachtrieb, S. B., *Johns Hopkins University.* (*1883.*)
W. L. Norris, *Arlington, Ill.* (*1881.*)
E. A. Nunn, *Professor of Biology, Wellesley College, Mass.* (*1879.*)
H. L. Osborn, A. B., *Johns Hopkins University.* (*1882, '83.*)
Henry F. Osborne, A. B., *Fellow, College of New Jersey.* (*1880.*)
J. H. Pillsbury, *Professor of Natural Science, Springfield (Mass.) High School.* (*1882, '83.*)
H. J. Rice, M. S., *Teacher of Natural Science, Brooklyn, N. Y.* (*1879, '81.*)
Fernando Sanford, *Professor, Natural Sciences, Mount Morris College, Ill.* (*1881.*)
August Schmidt, *Teacher of Natural Science, Baltimore.* (*1878, '79.*)
H. Sewall, Ph. D., *Professor of Physiology, University of Michigan.* (*1878, '81, '83.*)
C. Sihler, Ph. D., *Physician, Cleveland, Ohio.* (*1878, '79.*)
W. E. Stratton, A. B., *Johns Hopkins University.* (*1883.*)
A. H. Tuttle, S. B., *Professor of Zoölogy, Ohio State University, Columbus, Ohio.* (*1883.*)
John M. Tyler, A. B., *Professor of Zoölogy, Amherst College.* (*1882.*)
P. R. Uhler, *Associate in Natural History, J. H. U.* (*1881.*)
N. B. Webster, *Principal, Military Academy, Norfolk, Va.* (*1878.*)
T. B. Webster, *Teacher, Military Academy, Norfolk, Va.* (*1878.*)
E. B. Wilson, Ph. D., *Lecturer on Biology, Williams College.* (*1879–82.*)
H. V. Wilson, A. B., *Johns Hopkins University.* (*1883.*)
J. M. Wilson, M. D., *Ann Arbor, Mich.* (*1882.*)
Francis Winslow, *Lieut. United States Navy, United States Fish Commission.* (*1882, '83.*)

Published Results of Scientific Research at the Chesapeake Zoölogical Laboratory, 1878–83.

W. K. Brooks, Ph. D.:

The Development of Lingula and the Systematic Position of the Branchiopoda. (*Scientific Results, Chesapeake Zoöl. Lab.*, 1879; *Arch. f. Zoöl. exp.*, 1881.)

The Larval Stages of Squilla empusa. (*Scientific Results, Chesapeake Zoöl. Lab.*, 1879.)

Abstract of Observations on the Development of the American Oyster. (*Zoöl. Anzeiger*, 1879.)

The Artificial Fertilization of Oyster Eggs and the Propagation of the American Oyster. (*Am. Jour. of Science*, 1879.)

The Development of the American Oyster. (*Report of the Maryland Fish Commission, and Studies from the Biol. Lab., J. H. U.*, 1880.)

The Acquisition and Loss of a Food Yolk in Molluscan Eggs. (*Studies from the Biol. Lab., J. H. U.*, 1880; 10 *plates.*)

The Development of the Cephalopoda and the Homology of the Cephalopod Foot. (*Am. Jour. of Science*, 1880.)

The Rhythmical Character of Segmentation. (*Am. Jour. of Science*, 1880.)

Budding in Free Medusæ. (*Am. Nat*, *Sept.*, 1880.)

Embryology and Metamorphosis of the Sergestidae. (*Zoöl. Anzeiger, Nov.*, 1880.)

The Young of the Crustacean Lucifer, A Nauplius. (*Am. Nat., Nov.*, 1880.)

The Development of the Squid. (*Anniv. Mem., Boston Soc. Nat. Hist., March*, 1881; 3 *plates.*)

Alternation of Periods of Rest with Periods of Activity in the Segmenting Eggs of Vertebrates. (*Studies from the Biol. Lab., J. H. U.*, 1881; 1 *plate.*)

The First Zoea of Porcellana. (With E. B. Wilson; *Studies from the Biol. Lab., J. H. U.*, 1881; 2 *plates.*)

List of the Medusae of Beaufort, N. C. I. (*Studies from the Biol. Lab., J. H. U.*, 1882.)

Origin of the Eggs of Salpa. (*Studies from the Biol. Lab., J. H. U.*, 1882; 1 *plate.*)

Lucifer: A Study in Morphology. (*Proc., Royal Soc., London*, 1881.)

The Development of Lucifer. (*Phil. Trans. Royal Soc., London*, 1882; 11 *plates.*)

Handbook of Invertebrate Zoölogy. (*Boston, Cassino*, 1882.)

Chamisso and the Discovery of Alternation of Generations. (*Zoöl. Anzeiger*, 1882.)

The Development of the Digestive Tract in Molluscs. (*Proc., Boston Soc. Nat. Hist.*, 1879.)

The Metamorphosis of Alpheus. (*Univ. Circular, No.* 17.)

The Metamorphosis of Penaeus. (*Univ. Circular, No.* 19.)

On the Origin of Alternation of Generations in Hydro-Medusae. (*Univ. Circular, No.* 22; *Ann. of Nat. Hist.*, Vol. 11, p. 455.)

Notes on the Medusae of Beaufort, N. C. II. (*Studies from the Biol. Lab., J. H. U.*, 1883.)

The Law of Heredity. (*Baltimore, Murphy*, 1883.)

W. Bateson:

Abstract of Observations on the Development of Balanoglossus. (*Univ. Circular, No.* 27.)

H. G. Beyer, M. D.—(See H. W. Conn.)

E. A. Birge:

Notes on the Development of Panopaeus Sayi. (*Studies from the Biol. Lab., J. H. U.*, 1883, 4 *plates.*)

S. F. Clarke, Ph. D.:

New Hydroids from Chesapeake Bay. (*Boston Soc. Nat. Hist.*, 1882.)

B. P. Colton, A. B.—(See H. Garman.)

H. W. Conn, A. M.:

Development of Tubularia Cristata. (*Univ. Circular, No.* 17.)

On Radial and Bilateral Symmetry in Animals. (*Univ. Circular, No.* 22; *Ann. of Nat. Hist.*, Vol. 12, p. 69; *Journal Royal Mic. Soc.*, Vol. 3, p. 633.)

An Instance of Sexual Variation in the Crustacea. (*Univ. Circular, No.* 27.)

Evidence of a Protozoea Stage in Crab Development. (*Univ. Circular, No.* 28.)

The Nervous System of Porpita. (With H. G. Beyer. *Studies from the Biol. Lab. J. H. U.*, 1883, 1 *plate.*)

Evolution of Decapod Zoea. (*Science, April*, 1884, *in press.*)

Significance of the Larval Skin of Decapods. (*Studies from the Biol. Lab., J. H*

2 *plates.*)

Life History of Thalassema. Abstract. (*Studies from the Biol. Lab., J. H. U.*, 18

H. Garman:

List of a few additions to the Species of Birds, Reptiles, and Batrachians men

Dr. Elliott Coues' paper on the Natural History of Fort Macon and Vicinit

Circular, No. 22.)

Development of Arbacia punctulata. (With B. P. Colton. *Studies from the*

J. H. U., 1881.)

J. P. McMurrich:

Origin of the so-called Test Cells in the Ascidian ovum. (*Studies from the*

J. H. U., 1882.)

Abstract of Observations on the Osteology and Development of Syngnathus

(Storer.) (*Univ. Circular, No.* 27.)

On the Osteology and Development of Syngnathus Peckeanus (Storer.) (*Q*

nal Micros. Science, Vol. XXIII, 2 *plates.*)

K. Mitsukuri, Ph. D.:

On the Structure and Significance of some Abberant Forms of Lamellibranch

(*Quar. Jour. Micros. Sci., July*, 1881; *Studies from the Biol. Lab., J. H. U.*, 18

H. L. Osborn, A. B.:

The Structure and Growth of the Shell of the Oyster. (*Studies from the*

J. H. U., 1882, 1 *plate.*)

On the Growth of the Molluscan Shell. (*Univ. Circular, No.* 27; *Ann. of Nat.*

11, *p.* 149; *Am. Nat*, *Vol.* 17, *p.* 96; *Journal Royai Micros. Soc., Vol.* 3, *p.* 195.)

Of the Gill in some forms of Prosobranchiate Mollusca. (*Studies from the*

J. H. U., 1884, 3 *plates.*)

—Also see J. M. Wilson.

H. Sewall, Ph. D.:

On the Equilibrium Function of the Membraneous Labyrinth in Cartilagino

(*Univ. Circular, No.* 12; *Journal of Physiology, Vol. IV, No.* 6, 1884.)

P. R. Uhler:

List of Animals observed at Fort Wool, Va. (*Studies from the Biol. Lab. J. H.*

N. B. Webster:

Partial List of Land Plants at Fort Wool, Va. (*Studies from the Biol. Lab., J. H*

E. B. Wilson, Ph. D.:

The Early Stages of Renilla. (*Am. Jour. of Science*, 1880.)

Origin and Significance of the Metamorphosis of Actinotrocha. (*Quar. Jour.*

Sc., April, 1881, 2 *plates*; *Abstract in Am. Nat.*. 1882.)

The First Zoea of Porcellana. (With W. K. Brooks; *Studies from the Biol. Lab*

1881, 2 *plates.*)

Observations on the Early Developmental Stages of some Polychætous A

(*Studies from the Biol Lab., J. H. U.*, 1882; *Abstract in Zoöl. Anzeiger*, 1880, *a*

Jour. of Science, 1880.)

A New Species of Pilidium. (*Studies from the Biol. Lab., J. H. U.*, 1882.)

Abstract of Observations on the Structure and Development of Renilla and Le

(*Univ. Circular, No.* 17.)

The Development of Renilla. (*Proc., Royal Soc., London, No.* 222; *Univ. Circul*

—Also see J. M. Wilson and W. K. Brooks.

J. M. Wilson, M. D.:

Variation in the Segmentation of the Egg of Renilla. (With E. B. Wilson

Osborn; *Zoöl. Anzeiger*, 1882, No. 123; *Archiv f. Zoöl. exper.*, 1883.)

Dr. E. B. Wilson's monograph on the Development of Renilla is now in pri
will soon appear with sixteen quarto plates, in the *Philosophical Transactions o*
Society. Several other papers are now ready for publication. One of these,
the Development of Thallassema, by Mr. H. W. Conn, has received one of th
prizes of the Boston Society of Natural History.

STUDIES FROM THE BIOLOGICAL LABORATORY.

(*Including the Chesapeake Zoölogical Laboratory.*)

The *Studies from the Biological Laboratory* are published under the direction of Professor Newell Martin, Editor, and Dr. W. K. Brooks, Associate Editor. Two volumes have been issued: Vol. I (1879–80), 500 pp., 40 plates; Vol. II (1881–83), 496 pp., 37 plates.

Vol. III., No. 1, is now ready. It contains papers on:

The Significance of the Larval Skin of Decapods. (27 pp., 2 plates). By H. W. Conn.

Life History of Thalassema. (7 pp., 1 plate). By H. W. Conn.

Of the Gill in some forms of prosobranchiate Mollusca. (12 pp., 1 plate). By H. L. Osborn.

The "*Studies*" contain the majority of the original scientific papers published by members of the Biological Department of the University.

In future they will appear in numbers issued at intervals as mat
publication is ready. To each of these numbers will be affixed
dependent on its size and the number and cost of plates printed
These numbers may be purchased separately or all of them wil
warded as published to persons who subscribe in advance for th
volume. The subscription price for the volume of about 500 pages,
prepaid, is $5.00. Price of Vol. III, No. 1, 70 cents.

As in future no articles will be reprinted from the *Journal of P*
the "*Studies*" will no longer be sold at a reduced price to the subsc
that Journal.

Remittances and propositions for exchange should be addresse
"Publication Agency of the Johns Hopkins University."

not only led to ten physiological experimenters for each one who would have worked without them, but by making it possible to introduce into the regular course of physiological teaching demonstrations and experiments on living animals, without shocking the moral sense of students or of the community at large, has contributed incalculably to the progress of physiology.

On the occasion of the opening of the old laboratory I used these words: * —

> "Physiology is concerned with the phenomena going on in living things, and vital phenomena cannot be observed in dead bodies; and from what I have said you will have gathered that I intend to employ vivisections in teaching. I want, however, to say, once for all, that here, for teaching purposes, no painful experiment will be performed. Fortunately the vast majority of physiological experiments can nowadays be performed without the infliction of pain; either by the administration of some of the many anaesthetics known, or by previous removal of parts of the central nervous system; and such experiments only will be used here for teaching. With regard to physiological research, the case is different. Happily here, too, the number of necessarily painful experiments is very small indeed; but in any case where the furtherance of physiological knowledge is at stake—where the progress of that science is concerned, on which all medicine is based, so far as it is not a mere empiricism—I cannot doubt that we have a right to inflict suffering upon the lower animals, always provided that it be reduced to the minimum possible, and that none but competent persons be allowed to undertake such experiments."

Those words were a declaration of principle, and a pledge given to this community, in which I was about to commence my work. That the work has been carried on for seven years among you, without a murmur of objection reaching my ears, is sufficient proof that Baltimore assents to the principle; and, gratifying as the building of our new laboratory is to me from many points of view, there is none so grateful as its witness, that, in the opinion of our trustees and of my fellow-citizens, I have carried out my pledge. There has been no hole-and-corner secrecy about the matter: the students in the laboratory have been no clique living isolated in a college building; but either your own sons, or boarders scattered among dozens of families in this city; and no room in the laboratory has ever been closed to any student: what we have done has been open to all who cared to know. On this occasion, when we make a fresh start, I desire to re-assert the principle, and repeat the pledge.

We have seen that Haller laid the foundation of our knowledge that the body of one of the higher animals is essentially an aggregation of many organs, each having a sort of life of its own, and in health co-operating harmoniously with others for the common good. In the early part of this century, before scientific thought had freed itself from mediaeval guidance, this doctrine sometimes took fantastic forms. For example, a school arose which taught that each organ represented some one of the lower animals. DuBois-Reymond relates that in 1838 he took down these notes at the lectures of the professor of anthropology: —

> "Each organ of the human body answers to a definite animal, is an animal. For example, the freely movable, moist, and slippery tongue is a cuttlefish. The bone of the tongue is attached to no other bone in the skeleton; the cuttlefish has only one bone, and consequently this bone is attached to no other. It follows that the tongue is a cuttlefish."

However, while Professor Steffens and his fellow transcendentalists were theorizing about organs, others were at work studying their structure; and a great step forward was made in the first year of our century by the publication of Bichât's 'Anatomie générale.' Bichât showed that the organs of the body were not the ultimate living units, but were made up of a number of different interwoven textures, or *tissues*, each having vital properties of its own. This discovery paved the way for Schwann and Schleiden, who laid the foundation of the cell-theory; and showed, that, in fundamental structure, animals and plants are alike, the tissues of each being essentially made up of aggregates of more or less modified microscopic living units called *cells*. Our own generation has seen this doctrine completed by the demonstration that the essential constituent of the cell is a peculiar form of matter named protoplasm, and that all the essential phenomena of life can be manifested by microscopic bits of this material; that they can move, feed, assimilate, grow, and multiply; and still further, that, wherever we find any characteristic vital activity, we find some variety of protoplasm. Physiology thus has become reduced in general terms to a study of the faculties of protoplasm; and morphology to a study of the forms which units or aggregates of units of protoplasm, or their products, may assume. The isolation of botany, zoölogy, and physiology, which was threatened through increased division of labor, due to increase of knowledge necessitating a limitation of special study to some one field of biology, was averted; and the reason was given for that principle which we have always insisted upon here,—that beginners shall be taught the broad general laws of living matter before they are permitted to engage in the special study of one department of biology.

If I be asked, what have biological science in general and physiology in particular done for mankind to justify the time and money spent on them during the past fifty years, I admit it to be a perfectly fair question; fortunately it is one very easy to answer. Leaving aside the fruitful practical applications of biological knowledge to agriculture and sanitation, I will confine myself to immediate applications of the biological sciences to the advance of the theory, and, as a consequence, of the art of medicine.

So long as the life of a man was believed to be an external something distinct from his body, but residing in it for a while, diseases were naturally regarded as similar extrinsic essences or entities, which invaded the body from without, and fought the 'vital force.' The business of the physician was to drive out the invader without expelling the vital spirits along with it,—an unfortunate result, which only too often happened. To the physicians of the sixteenth century a fever was some mysterious extraneous thing, to be bled, or sweated, or starved out of the body, much as the medicine-men of savages try to scare it off by beating tomtoms around the patient. Once life was recognized as the sum total of the properties of the organs composing the body such a theory of disease become untenable, and the basis of modern pathology was laid. Disease was no longer a spiritual indivisible essence, but the result of change in the structure of some one or more of the material constituents of the body, leading to abnormal action. The object of the physician became, not to expel an imaginary immaterial enemy, but to restore the altered constituent to its normal condition.

The next great debt which medicine owes to biology is the establishment of the cell-doctrine,—of the fact that the body of each one of us is made up of millions of little living units, each with its own properties, and each in health doing its own business in a certain way under certain conditions; and no one cell being more the seat of life than any other. The activities of certain cells may, indeed, be more fundamentally important to the maintenance of the general life of the aggregate than that of others; but the cells, which, by position or function, are more essential than the rest, are, in final analysis, no more alive than they. Before the acceptance of the cell-doctrine pathologists were practically divided into two camps,—those who believed that all disease was primarily due to changes in the nervous system, and those who ascribed it to alteration of the blood. With the publication of Virchow's 'Cellular pathology' all this was changed. Physicians recognized that the blood and nerves might at the outset be all right, and yet disease originate from abnormal growth or action of the cells of various organs. This new pathology, like the older, was for a time carried to excess. We now know that there may be general diseases primarily due to changes in the nervous system, which binds into a solidarity the organs of the body; or of the blood, which nourishes all: but we have also gained the knowledge that very many, if not the majority, of diseases have a local origin, due to local causes, which must be discovered if the disease is to be successfully combated. An engineer, if he find his machinery running imperfectly, may endeavor to overcome this by building a bigger fire in his furnace, and loading the safety-valve. In other words, he may attribute the defect to general causes; and in so far he would resemble the old pathologists. But the skilled engineer would do something different. If he found his machinery going badly, he would not jump forthwith to the conclusion that it was the fault of the furnace, but would examine every bearing and pivot in his machinery, and, only when he found these all in good working-order, begin to think the defect lay in the furnace or boiler; and in that he would resemble the modern physician instructed in the cell-doctrine.

A third contribution of biology to medical science is the germ-theory as to the causation of an important group of diseases. To it we owe already antiseptic surgery; and we are all now holding our breath in the fervent expectation that in the near future, by its light, we may be able to fight scarlet-fever, diphtheria, and phthisis, not in the bodies of those we love, but in the breeding-places, in dirt and darkness, of certain microscopic plants.

From one point of view the germ-theory may seem a return to the idea that diseases are external entities which attack the body; but note the difference between this form of the doctrine and the ancient! We are no

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* *Pop. sc. monthly*, December, 1876.

PROCEEDINGS OF SOCIETIES.

Scientific Association.

March 5.—Fifty-sixth regular meeting. Professor Martin in the chair. Twenty-five members present.

Papers read:

On the Glucose Industry in the United States, by I. Remsen.

On the Gastropod Gill, by H. L. Osborn.

On a Case of Endocarditis in a Dog, by W. T. Councilman.

April 2.—Fifty-seventh regular meeting. Professor Martin in the chair. Twenty members present.

Papers read:

On Compound Reaction Time, by G. Stanley Hall.

On the Coagulation of the Blood, by W. H. Howell.

Philological Association.

March 7.—Fifty-third regular meeting. Professor Gildersleeve in the chair. Thirty-three members present.

Papers read:

On Uniformity and Analogy, by Professor M. W. Easton of the University of Pennsylvania, presented and criticised by M. Bloomfield. (*Abstract on p.* 73).

On the Nahuatl Spanish Dialect of Nicaragua, by A. M. Elliott. (*Abstract on p.* 74).

April 4.—Fifty-fourth regular meeting. Professor Gildersleeve in the chair. Thirty-five members present.

Papers read:

On Rhythmical Pronunciation of Greek and Latin Prose and a few remarks on Accent, by C. W. E. Miller.

On Parallelisms in Beowulf, by C. B. Wright.

Historical and Political Science Association.

February 29.—Dr. H. B. Adams in the chair.

Luther Martin, a Biographical Study, by H. P. Goddard.

Martin was for fifty years the leader of the Maryland bar and twice held the office of Attorney General. A bitter opponent of the Constitution in 1787, he afterwards became a strict constructionist and an advocate of State's rights. He was one of the counsel for the defence in the trials of Judge Chase and Aaron Burr. In 1822 the latter took Martin to his own home in New York, where the once brilliant Maryland advocate died, a mental wreck, in 1826, at the age of 78.

March 7.—Dr. H. B. Adams in the chair.

The Development of the Passover Scandal, by J. Rendel Harris.

The paper established the historical continuity of the calumnies concerning the use of human flesh and blood at religious banquets from the times of the early Christians down to the persecuted Jews in modern Hungary. The charges made by Jews and Pagans against Christians were subsequently transferred by the latter and made against herectical sects, *e. g.*. the Montanists, and, in the course of the middle ages, these charges were brought home to the Jews. Almost every Christian nation has had some legend of child-sacrifice by the Jews like that illustrated by Hugh of Lincoln.

March 14.—Dr. R. T. Ely in the chair.

Moses as a Statesman, by John Dunlap, Esq., of Richmond, Va.

This paper related to Hebrew civic, religious, and military institutions, to penal law, administration, etc.

March 21.—Dr. H. B. Adams in the chair.

Additional Notes on Icaria, by Albert Shaw. (*Abstract on p.* 77).

Rudimentary Society among Boys. Part I. Land Tenure, by John Johnson.

Review of the American edition of Laveleye's Elements of Political Economy, edited by Dr. Taussig, by R. T. Ely.

Review of the Hon. A. C. Goodell's monographs on the History of Witchcraft, the Seals of Massachusetts, etc., by J. F. Jameson.

March 28.—Dr. H. B. Adams in the chair.

Tammany Hall, a Study of New York City Politics, by Talcott Williams, of *The Press*, Philadelphia.

April 4.—Dr. H. B. Adams in the chair.

Old Teutonic Life in Beówulf, by James A. Harrison.

The paper is an attempt to reconstruct an outline of Old Teutonic life as contained in *Beówulf*, a poem of the eighth or ninth century written in Anglo-Saxon. Though the texture of the poem is Dano-Scandinavian, this poem was found to contain much that could be called in general Teutonic; it is filled with folk-lore, superstitions, customs, traces of ancient, and foreshadowings of modern life; a reservoir of dynastic traditions and legends very valuable to the student of the origins of Germanic history.

Samuel Adams, the Man of the Town-Meeting, by James K. Hosmer.

Society for Semitic Philology.

December 13.—First meeting. Professor Haupt in the chair. Seven members present.

Papers read:

The City of Harran and its Place in Ancient History, by C. Adler.

Harran and its Condition after the Christian Era, by A. L. Frothingham Jr.

The People and Language of the Medes founded on Delattre "Le Peuple et l'Empire des Mèdes," by C. Lehmann.

An etymology of the Name of S. Luke given by Isidore of Seville, by J. Rendel Harris.

Dr. A. L. Frothingham Jr., was elected Secretary.

January 13.—Second meeting. Professor Haupt in the chair. Eight members present.

Papers read:

The Differences in the Pronunciation of many Letters in Hebrew among the Jews of different countries of Europe, by C. Adler.

The History of Syriac Literature from the beginning of the Christian Era t period of the Mohammedan Conquest, by A. L. Frothingham Jr. (*Abstract* 75).

February 28.—Third meeting. Professor Haupt in the chair. Seven members pre

Papers read:

The Massora and its Critical and Editorial Treatment, by A. H. Huizinga.

The history of Syriac Literature from the Mohammedan Conquest to its extin in the XIII century (continued), by A. L. Frothingham Jr. (*Abstract on p*

March 17.—Fourth meeting. Professor Haupt in the chair. Nine members prese

Papers read:

The exchange of *šin* and *sun* in the Proto-Babylonian Language, by C. Lehman

A Hebrew MS. of C. 1300 important for its various readings of the Old Testament by C. Adler.

Semitic loan-words in Old Greek, by W. M. Arnolt.

Mathematical Society.

March 19.—Dr. Story in the chair. Eleven members present.

Papers read:

On a System of Straight Lines determined by two Given Lines, by W. E. Story.

A Certain Class of Transcendental Functions, by T. Craig.

A Note on Partitions, by G. S. Ely. (*Abstract on p.* 76).

Unicursal Curves in *n*-Flat Space, by G. Bissing. (*Abstract on p.* 77).

A Note on Cycles, by A. S. Hathaway.

Some Remarks on Unicursal Curves, by E. W. Davis.

Metaphysical Club.

March 11.—Thirty-seventh regular meeting. Dr. G. Stanley Hall in the chair. teen members present.

Papers read:

The New Psychology, by J. Dewey.

The Body as a Spiritual Residence, by E. M. Hartwell.

Archæological Society.

March 14.—Second general meeting. Dr. Adams in the chair. Fourteen mem present.

Paper:

Report on the Collection of Casts in the Peabody Institute, by L. Hoskins.

This paper was drawn up with the object of showing what field the colle covered and what opportunity for study it afforded to the Society.

Address:

On the Entasis in Greek Architecture, by J. T. Clarke. (*Abstract on p.* 83).

March 22.—Third general meeting. Professor Gildersleeve in the chair. Thirty members present.

Address:

On the Acropolis of Athens, by W. J. Stillman. (*Abstract on p.* 83).

Report:

On the Library of the Peabody Institute (Ancient Art), by A. Emerson.

Baltimore Naturalists' Field Club.

February 20.—Dr. G. H. Williams in the chair. Twenty members present.

Communications:

On Economic Entomology, by O. Lugger.

This paper treated of the excessive insect depredations in the United States their causes.

On the Peculiarities of certain Linden trees on Cathedral street, by B. W. Ba

These trees show at different heights from the pavement large swellings, the r for which has not been clearly understood. It was shown that the swellings caused by the grafting of the European Linden on the American bass-

Mr. Bruck gave an account of the bad-lands in the south-western part of Da noted for the abundance of fossil remains of extinct animals to be found the

March 19.—Dr. G. H. Williams in the chair. Fifteen members present.

Communications:

On Insects injurious to Herbaria, by O. Lugger,

In looking over a collection of 3500 species of alpine plants of Europe present this University by Dr. A. F. W. Schimper, several species of injurious in were found. Amongst them were the Sitodrepa panicea, Ptinus fur, and a destructive species of Ptinus not found before in this country. The species named belong to the family of Ptinidæ, popularly known as the d watch. Two species of the apterous Psocus were also found in limited num

Mr. Webster made a report on the map of the region around Baltimore wh being prepared. (*Abstract on p.* 80).

Dr. Barton read some notes in Botany. He gave an account of some yellow mine visited by humble bees.

The bees were unable to get at the nectar from the mouth of the corolla and obliged to puncture it from the base. They died, however, from its ef Several seeds were described, apparently oat-seeds, having on the back a awm bent near the middle. The thigh of this leg-like awm was found spirally twisted and if held fast and moistened the seed attached was turned its axis. The theory was advanced that by its hygroscopic quality when the was dropped and covered by drifting sand and moistened by rain, the unwindi the awm now held fast in the sand would bore the seed into the earth to a d sufficient to insure germination.

THE AS BRARY
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[This Number is especially devoted to the Programmes for the Next Academic Year and to Statements of the Work of the Past Year].

JOHNS HOPKINS UNIVERSITY CIRCULARS

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PROCEEDINGS OF SOCIETIES.

Scientific Association.

March 5.—Fifty-sixth regular meeting. Professor Martin in the chair. Twenty-five members present.

Papers read :

On the Glucose Industry in the United States, by I. Remsen.

On the Gastropod Gill, by H. L. Osborn.

On a Case of Endocarditis in a Dog, by W. T. Councilman.

April 2.—Fifty-seventh regular meeting. Professor Martin in the chair. Twenty members present.

Papers read :

On Compound Reaction Time, by G. Stanley Hall.

On the Coagulation of the Blood, by W. H. Howell.

Philological Association.

March 7.—Fifty-third regular meeting. Professor Gildersleeve in the chair. Thirty-three members present.

Papers read :

On Uniformity and Analogy, by Professor M. W. Easton of the University of Pennsylvania, presented and criticised by M. Bloomfield. (*Abstract on p.* 73).

On the Nahuatl Spanish Dialect of Nicaragua, by A. M. Elliott. (*Abstract on p.* 74).

April 4.—Fifty-fourth regular meeting. Professor Gildersleeve in the chair. Thirty-five members present.

Papers read :

On Rhythmical Pronunciation of Greek and Latin Prose and a few remarks on Accent, by C. W. E. Miller.

On Parallelisms in Beowulf, by C. B. Wright.

Historical and Political Science Association.

February 29.—Dr. H. B. Adams in the chair.

Luther Martin, a Biographical Study, by H. P. Goddard.

Martin was for fifty years the leader of the Maryland bar and twice held the office of Attorney General. A bitter opponent of the Constitution in 1787, he afterwards became a strict constructionist and an advocate of State's rights. He was one of the counsel for the defence in the trials of Judge Chase and Aaron Burr. In 1822 the latter took Martin to his own home in New York, where the once brilliant Maryland advocate died, a mental wreck, in 1826, at the age of 78.

March 7.—Dr. H. B. Adams in the chair.

The Development of the Passover Scandal, by J. Rendel Harris.

The paper established the historical continuity of the calumnies concerning the use of human flesh and blood at religious banquets from the times of the early Christians down to the persecuted Jews in modern Hungary. The charges made by Jews and Pagans against Christians were subsequently transferred by the latter and made against herectical sects, *e. g.*. the Montanists, and, in the course of the middle ages, these charges were brought home to the Jews. Almost every Christian nation has had some legend of child-sacrifice by the Jews like that illustrated by Hugh of Lincoln.

March 14.—Dr. R. T. Ely in the chair.

Moses as a Statesman, by John Dunlap, Esq., of Richmond, Va.

This paper related to Hebrew civic, religious, and military institutions, to penal law, administration, etc.

March 21.—Dr. H. B. Adams in the chair.

Additional Notes on Icaria, by Albert Shaw. (*Abstract on p.* 77).

Rudimentary Society among Boys. Part I. Land Tenure, by John Johnson.

Review of the American edition of Laveleye's Elements of Political Economy, edited by Dr. Taussig, by R. T. Ely.

Review of the Hon. A. C. Goodell's monographs on the History of Witchcraft, the Seals of Massachusetts, etc., by J. F. Jameson.

March 28.—Dr. H. B. Adams in the chair.

Tammany Hall, a Study of New York City Politics, by Talcott Williams, of *The Press*, Philadelphia.

April 4.—Dr. H. B. Adams in the chair.

Old Teutonic Life in Beówulf, by James A. Harrison.

The paper is an attempt to reconstruct an outline of Old Teutonic life as contained in *Beówulf*, a poem of the eighth or ninth century written in Anglo-Saxon. Though the texture of the poem is Dano-Scandinavian, this poem was found to contain much that could be called in general Teutonic; it is filled with folk-lore, superstitions, customs, traces of ancient, and foreshadowings of modern life; a reservoir of dynastic traditions and legends very valuable to the student of the origins of Germanic history.

Samuel Adams, the Man of the Town-Meeting, by James K. Hosmer.

Society for Semitic Philology.

December 13.—First meeting. Professor Haupt in the chair. Seven members present.

Papers read :

The City of Harran and its Place in Ancient History, by C. Adler.

Harran and its Condition after the Christian Era, by A. L. Frothingham Jr.

The People and Language of the Medes founded on Delattre "Le Peuple et l'Empire des Mèdes," by C. Lehmann.

An etymology of the Name of S. Luke given by Isidore of Seville, by J. Rendel Harris.

Dr. A. L. Frothingham Jr., was elected Secretary.

January 13.—Second meeting. Professor Haupt in the chair. Eight members present.

Papers read :

The Differences in the Pronunciation of many Letters in Hebrew among the Jews of different countries of Europe, by C. Adler.

The History of Syriac Literature from the beginning of the Christian Era to the period of the Mohammedan Conquest, by A. L. Frothingham Jr. (*Abstract on p.* 75).

February 28.—Third meeting. Professor Haupt in the chair. Seven members present.

Papers read :

The Massora and its Critical and Editorial Treatment, by A. H. Huizinga.

The history of Syriac Literature from the Mohammedan Conquest to its extinction in the XIII century (continued), by A. L. Frothingham Jr. (*Abstract on p.* 75).

March 17.—Fourth meeting. Professor Haupt in the chair. Nine members present.

Papers read :

The exchange of *šin* and *sun* in the Proto-Babylonian Language, by C. Lehmann.

A Hebrew MS. of C. 1300 important for its various readings of the Old Testament text, by C. Adler.

Semitic loan-words in Old Greek, by W. M. Arnolt.

Mathematical Society.

March 19.—Dr. Story in the chair. Eleven members present.

Papers read :

On a System of Straight Lines determined by two Given Lines, by W. E. Story.

A Certain Class of Transcendental Functions, by T. Craig.

A Note on Partitions, by G. S. Ely. (*Abstract on p.* 76).

Unicursal Curves in *n*-Flat Space, by G. Bissing. (*Abstract on p.* 77).

A Note on Cycles, by A. S. Hathaway.

Some Remarks on Unicursal Curves, by E. W. Davis.

Metaphysical Club.

March 11.—Thirty-seventh regular meeting. Dr. G. Stanley Hall in the chair. Sixteen members present.

Papers read :

The New Psychology, by J. Dewey.

The Body as a Spiritual Residence, by E. M. Hartwell.

Archæological Society.

March 14.—Second general meeting. Dr. Adams in the chair. Fourteen members present.

Paper :

Report on the Collection of Casts in the Peabody Institute, by L. Hoskins.

This paper was drawn up with the object of showing what field the collection covered and what opportunity for study it afforded to the Society.

Address :

On the Entasis in Greek Architecture, by J. T. Clarke. (*Abstract on p.* 83).

March 22.—Third general meeting. Professor Gildersleeve in the chair. Thirty-one members present.

Address :

On the Acropolis of Athens, by W. J. Stillman. (*Abstract on p.* 83).

Report :

On the Library of the Peabody Institute (Ancient Art), by A. Emerson.

Baltimore Naturalists' Field Club.

February 20.—Dr. G. H. Williams in the chair. Twenty members present.

Communications :

On Economic Entomology, by O. Lugger.

This paper treated of the excessive insect depredations in the United States and their causes.

On the Peculiarities of certain Linden trees on Cathedral street, by B. W. Barton.

These trees show at different heights from the pavement large swellings, the reason for which has not been clearly understood. It was shown that the swellings were caused by the grafting of the European Linden on the American bass-wood.

Mr. Bruck gave an account of the bad-lands in the south-western part of Dakota, noted for the abundance of fossil remains of extinct animals to be found there.

March 19.—Dr. G. H. Williams in the chair. Fifteen members present.

Communications :

On Insects injurious to Herbaria, by O. Lugger.

In looking over a collection of 3500 species of alpine plants of Europe presented to this University by Dr. A. F. W. Schimper, several species of injurious insects were found. Amongst them were the Sitodrepa panicea, Ptinus fur, and a very destructive species of Ptinus not found before in this country. The three species named belong to the family of Ptinidæ, popularly known as the death-watch. Two species of the apterous Psocus were also found in limited numbers.

Mr. Webster made a report on the map of the region around Baltimore which is being prepared. (*Abstract on p.* 80).

Dr. Barton read some notes in Botany. He gave an account of some yellow jessamine visited by humble bees.

The bees were unable to get at the nectar from the mouth of the corolla and were obliged to puncture it from the base. They died, however, from its effects. Several seeds were described, apparently oat-seeds, having on the back a long awm bent near the middle. The thigh of this leg-like awm was found to be spirally twisted and if held fast and moistened the seed attached was turned upon its axis. The theory was advanced that by its hygroscopic quality when the seed was dropped and covered by drifting sand and moistened by rain, the unwinding of the awm now held fast in the sand would bore the seed into the earth to a depth sufficient to insure germination.

NY 568

[This Number is especially devoted to the Programmes for the Next Academic Year and to Statements of the Work of the Past Year].

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PROGRAMMES FOR 1884-85.

The following courses in literature and science are offered for the academic year which begins September 23, 1884. They are open to all properly qualified young men according to conditions varying somewhat in each department. Detailed statements as to the various subjects are given in the programmes of the departments of instruction on subsequent pages. A special Circular relating to College Courses has been issued.

The Annual Register giving detailed statements as to the regulations and work of the University will be sent on application.

B. L. GILDERSLEEVE, *Professor of Greek.*

(*a*) will direct the Greek Seminary. *Twice weekly, through the year.*
(*b*) will conduct a course of Practical Exercises in Greek. *Twice weekly, from October to January.*
(*c*) will lecture on the Greek Lyric Poets. *Weekly, after the first of January.*
(*d*) will give a course of lectures on the Syntax of the Greek Moods and Tenses.
(*e*) will hold a series of conferences on Greek Grammar. *Weekly, during the second half-year.*

G. STANLEY HALL, *Professor of Psychology and Pedagogics.*

(*a*) will lecture on Psycho-Physiology. *Twice weekly, through the year.*
(*b*) will direct the work of those engaged in Psycho-Physic research.
(*c*) will lecture on the History of Modern Philosophical and Educational Ideas. *Weekly, through the year.*
(*d*) will hold a series of conferences on Educational Topics.
(*e*) will direct the course required of matriculated students in Logic, Ethics, and Psychology.

PAUL HAUPT, *Professor of the Shemitic Languages.*

will give courses in
(*a*) Hebrew. *Four times weekly, through the year.*
(*b*) Chaldean Grammar, etc. *Weekly, through the year.*
(*c*) Ethiopic. *Weekly, through the year.*
(*d*) Arabic. *Weekly, through the year.*
(*e*) Assyrian. *Twice weekly, through the year.*
(*f*) Sumero-Akkadian. *Weekly, through the year.*

H. N. MARTIN, *Professor of Biology.*

(*a*) will direct the Laboratory Work in Biology. *Daily, through the year.*
(*b*) will lecture on Animal Physiology and Histology. *Three times weekly, through the year.*
(*c*) will lecture on General Biology. *Three times weekly, until the middle of April.*
(*d*) will lecture on the Embryology of the Chick. *Three times weekly, from the middle of April until the close of the session.*

C. D. MORRIS, *Collegiate Professor of Greek and Latin.*

will form classes in:—
(*a*) Plato, Gorgias. *Four times weekly, first half-year.*
(*b*) Aeschylus; Euripides. *Three times weekly, second half-year.*
(*c*) Cicero. *Three times weekly, first half-year.*
(*d*) Catullus; Martial. *Seven times in two weeks, second half-year.*
(*e*) Greek Prose Composition. *Weekly, through the year.*
(*f*) Reading Latin at Sight. *Weekly, through the year.*
(*g*) Latin Prose Composition. *Weekly, through the year.*
(*h*) will give a series of conferences on Greek History. *Weekly, first half-year.*

IRA REMSEN, *Professor of Chemistry.*

(*a*) will direct the Laboratory Work in Chemistry. *Daily, through the year.*
(*b*) will direct the courses of lectures to advanced students.
(*c*) will lecture on General Chemistry. *Four times weekly, first half-year.*
(*d*) will lecture on the Compounds of Carbons. *Four times weekly, second half-year.*

H. A. ROWLAND, *Professor of Physics.*

(*a*) will lecture on Electricity and Magnetism. *Four times weekly, through the year.*
(*b*) will direct a course of advanced work in the Physical Laboratory. *Daily, through the year.*
(*c*) will conduct meetings for the discussion of current Physical literature. *Weekly, through the year.*

SIR WILLIAM THOMSON, *Professor in the University of Glasgow.*

will give a course of eighteen lectures on Molecular Dynamics. *In October,* 1884.

H. B. ADAMS, *Associate Professor of History.*

(*a*) will direct the Seminary of Historical and Political Science. *Weekly, through the year.*
will give the following courses:—
(*b*) History of Politics. *Three times weekly, through the year.*
(*c*) Mediæval Church and State. *Twice weekly, first half-year.*
(*d*) the Italian Renaissance and the German Reformation. *Twice weekly, second half-year.*
(*e*) the Modern State System. *Twice weekly, through the year.*
(*f*) Introductory to the study of History. *Weekly, first half-year.*

M. BLOOMFIELD, *Associate Professor of Sanskrit.*
will give courses in :—
(*a*) Elementary Sanskrit.
(*b*) Advanced Sanskrit.
(*c*) Introduction into the Rig-Veda.
(*d*) Advanced Vedic Study.
(*e*) Introduction into Comparative Philology.
(*f*) Comparative Grammar of Greek.

W. K. BROOKS, *Associate Professor of Morphology.*
(*a*) will direct the work of the Marine Laboratory.
(*b*) will lecture on the Elements of Zoölogy.

T. CRAIG, *Associate Professor of Applied Mathematics.*
(*a*) will direct a Mathematical Seminary. *Weekly, through the year.*
will give courses in:—
(*b*) Theory of Functions including Elliptic Functions. *Three times weekly, through the year.*
(*c*) Calculus of Variations. *Twice weekly, first half-year.*
(*d*) Analytic Mechanics. *Three times weekly, first half-year.*
(*e*) Hydrodynamics. *Three times weekly, second half-year.*
(*f*) Partial Differential Equations. *Twice weekly, second half-year.*
(*g*) Total Differential Equations. *Twice weekly, through the year.*

A. M. ELLIOTT, *Associate Professor of the Romance Languages.*
(*a*) will give advanced courses in the Romance Languages. *Daily, through the year.*
(*b*) will lecture on French Philology and on French Literature of the Middle Ages.

J. RENDEL HARRIS, *Associate Professor of New Testament Greek and Palæography.*
will give courses in :—
(*a*) Palæography, with especial reference to the documents of the New Testament.
(*b*) New Testament and Patristic Greek.
(*c*) Church History.

G. S. MORRIS, *Lecturer on the History of Philosophy.*
will lecture, during the first half-year, on :—
(*a*) History of Philosophy in Greece. *Twice weekly.*
(*b*) Ethics or the Science of Man. *Twice weekly.*
(*c*) Modern Philosophy.

H. N. MORSE, *Associate Professor of Chemistry.*
(*a*) will assist in directing the Laboratory Work of the undergraduate students in Chemistry.
(*b*) will lecture on Analytical Chemistry. *Four times weekly, first half-year.*
(*c*) will conduct a course in General Chemistry. *Three times weekly, second half-year.*

L. RABILLON, *Lecturer on French Literature.*
will give a series of lectures on French Literature (in French).

W. E. STORY, *Associate Professor of Mathematics.*
(*a*) will direct a Mathematical Seminary. *Weekly, through the year.*
will give the following courses :—
(*b*) General Introductory Course for Graduates. *Five times weekly, through the year.*
(*c*) Theory of Numbers. *Twice weekly, first half-year.*
(*d*) Higher Algebra. *Twice weekly, second half-year.*
(*e*) Modern Synthetic Geometry. *Three times weekly, first half-year.*
(*f*) Quaternions. *Three times weekly, second half-year.*
(*g*) Conic Sections. *Twice weekly, through the year.*

M. WARREN, *Associate Professor of Latin.*
(*a*) will direct the Latin Seminary. *Twice weekly, through the year.*
(*b*) will give during the first half-year a course of lectures on the Roman Satirists.
(*c*) will conduct during the second half-year a series of Practical Exercises in Latin.
will form classes for undergraduates in :—
(*d*) Plautus; Terence. *Three times weekly, first half-year.*
(*e*) Tacitus. *Seven times in two weeks, second half-year.*
(*f*) Latin Prose Composition. *Weekly, through the year.*
(*g*) Reading Latin at Sight. *Once in two weeks, through the year.*

W. HAND BROWNE, *Examiner in English.*
will conduct courses in English. *Through the year.*

R. T. ELY, *Associate in Political Economy.*
will conduct courses in :—
(*a*) Finance and Taxation. *Three times weekly, through the year.*
(*b*) Comparative Studies in European Administration. *Weekly, through the year.*
(*c*) Elements of Political Economy. *Five times weekly, first half-year.*
(*d*) History of Political Economy. *Five times weekly, second half-year.*

F. FRANKLIN, *Associate in Mathematics.*
will give courses in :—
(*a*) Problems in Mechanics. *Twice weekly, through the year.*
(*b*) Differential and Integral Calculus. *Three times weekly, through the year.*
(*c*) Theory of Equations. *Three times weekly, first half-year.*
(*d*) Solid Analytical Geometry. *Three times weekly, second half-year.*
(*e*) Preparation for Matriculation in Trigonometry and Analytical Geometry.

J. F. JAMESON, *Associate in History.*
(*a*) will give a series of lessons upon the relation of Physical Geography to History.
(*b*) will teach French and English History. *Three times weekly, through the year.*
(*c*) will teach a class in the principles of the English and American Constitutions. *Three times weekly, through the year.*
(*d*) will teach a class in the history of Greece and Rome. *Twice weekly, through the year.*

A. L. KIMBALL, *Associate in Physics.*

(*a*) will direct the course of instruction for undergraduates in General Physics, including experimental lectures, recitations, etc. *Daily, through the year.*

(*b*) will give courses of lectures on selected topics to the major course students.

(*c*) will direct the work in the laboratory of the major and minor course students.

G. H. WILLIAMS, *Associate in Mineralogy.*

(*a*) will lecture on Mineralogy. *Weekly, first half-year; twice weekly, second half-year.*

(*b*) will lecture on General Inorganic Geology.

(*c*) will direct the practical work in Mineralogy and Petrography.

H. WOOD, *Associate in German.*

will conduct courses in German. *Through the year.*

A. EMERSON, *Instructor in Classical Archæology.*

will conduct courses in Classical Archæology.

E. M. HARTWELL, *Instructor in Physical Culture.*

will direct the instruction in Physical Culture.

E. H. SPIEKER, *Assistant in Greek and Latin.*

will teach undergraduate classes in Greek and Latin.

H. A. TODD, *Instructor in the Romance Languages.*

(*a*) will give instruction in French. *Daily, through the year.*

(*b*) will give instruction to special students in Italian and Spanish.

W. H. HOWELL, *Chief Assistant in Biology.*

(*a*) will direct the practical work of the undergraduate classes in Physiology and Histology.

(*b*) will give instruction in Plant Analysis.

E. H. KEISER, *Assistant in Chemistry.*

will assist in directing the work of the beginners in the Chemical Laboratory.

C. A. PERKINS, *Assistant in Physics.*

will assist in directing the work of the minor course students in Physics.

H. NEWELL, *Instructor in Drawing.*

will give instruction in free-hand and mechanical drawing, after 1 o'clock p. m. *Daily, through the year.*

C. L. WOODWORTH, *Instructor in Elocution.*

will give instruction in Vocal Culture. *Daily, through the year.*

O. LUGGER, *Curator of the Biological Museum.*

will have charge of the Museum of the Biological Laboratory.

ADMISSION OF STUDENTS.

Graduate, undergraduate, and special students are admitted to the University.

Advanced and graduate students are received with or without reference to their being candidates for a degree, and they are permitted to attend such lectures and exercises as they may individually select. They are not examined for admission to the University, but each instructor satisfies himself of the attainments of all who wish to follow his guidance before admitting them to his classes.

Undergraduate students of the following classes are received—(*a*) those who having passed a full matriculation examination are candidates for the degree of Bachelor of Arts, and who, on completing a definite amount of work in lines varying according to the needs or preferences of the student, are advanced to that degree;—(*b*) those who come with the intention of proceeding to the B. A. degree, but are from various causes unable at once to pass the examination for matriculation, and are admitted as candidates for it, if they show that their acquirements are such that they may reasonably be expected to complete the work in a moderate time;—(*c*) special students who do not aim at a university degree but desire only to prosecute one or more branches of study with the full advantages which the University affords to persons who are able to profit by them.

The next term will begin Tuesday, September 23, 1884, on which day the examinations for matriculation begin. The first week is devoted to the examination of candidates for admission and matriculation, and to the organization of classes. Instructions will be resumed Tuesday, September 30, 1884. The term of instruction closes on Friday, June 12, 1885. There will be a brief recess at the Christmas holidays and also in the early Spring.

For further information, during the summer vacation, letters should be addressed to the "Johns Hopkins University," Baltimore, Md., and not to the individual Professors, who are likely to be absent from the city.

MATHEMATICS.

PROGRAMME FOR 1884-85.

Graduate Courses.

DR. STORY:

General Introductory Course for Graduates (including Higher Algebra, Theory of Numbers, Probabilities, Higher Plane Curves, Surfaces and Twisted Curves, Quaternions, Calculus of Operations, Partial Differential Equations, Elliptic Functions, and Mechanics).
Five times weekly, through the year.

This course is intended as preparatory for all the more advanced courses, and candidates for the Doctor's degree in Mathematics are expected to take it in the first year of their candidacy, if they have not previously taken it.

Theory of Numbers.
Twice weekly, first half-year.

Higher Algebra.
Twice weekly, second half-year.

Modern Synthetic Geometry.
Three times weekly, first half-year.

Quaternions.
Three times weekly, second half-year.

Mathematical Seminary.
Weekly, through the year.

The exercises of this Seminary will consist of original work by the students, under the guidance of the Director, on a prescribed subject. After a few preparatory lectures the problem will be given to the class, and thereafter the students will be expected to make weekly reports of progress, which will be discussed, and from time to time new lines of research will be suggested. The subject for investigation in the first half of the ensuing year will be selected from the Theory of Numbers or Modern Geometry, and in the second half of the year from the Higher Algebra or Quaternions.

DR. CRAIG:

Theory of Functions (including Elliptic Functions).
Three times weekly, through the year.

Analytic Mechanics.
Three times weekly, first half-year.

Hydrodynamics.
Three times weekly, second half-year.

Calculus of Variations.
Twice weekly, first half-year.

Partial Differential Equations.
Twice weekly, second half-year.

Mathematical Seminary.
Weekly, through the year.

The subjects to which attention will be particularly directed are the Theory of Analytical Functions and Lamé's Functions. During the first two or three meetings of the Seminary the Director will occupy the hour, and after that time the students will read dissertations on subjects selected for them by the Director. The work assigned will be divided into three parts: solution of problems, the historical investigation of the above mentioned subjects, and reports on current mathematical journals.

DR. FRANKLIN:

Problems in Mechanics.
Twice weekly, through the year.

Historical Lectures on Mathematical Topics by the Instructors, Fellows, and some of the Graduate Students.
Once in two weeks, through the year.

Mathematical Society.

The Mathematical Society, composed of the instructors and advanced students, will meet monthly as heretofore for the presentation and discussion of papers or oral communications.

Undergraduate Courses.

FIRST YEAR:

Conic Sections.
Twice weekly, through the year. DR. STORY.

Differential and Integral Calculus.
Three times weekly, through the year. DR. FRANKLIN.

SECOND YEAR:

Total Differential Equations.
Twice weekly, through the year. DR. CRAIG.

Theory of Equations.
Three times weekly, first half-year. DR. FRANKLIN.

Solid Analytic Geometry.
Three times weekly, second half-year. DR. FRANKLIN.

Preparation for Matriculation in Trigonometry and Analytic Geometry.
Three or four times weekly, through the year. DR. FRANKLIN.

WORK OF THE PAST YEAR, 1883-4.

Professor Sylvester:
Algebra of Multiple Quantity. *Twice weekly, till the Christmas recess.*

Dr. Story:
Theory of Invariants. *Three times weekly, first half-year.*
Non-Euclidean Geometry. *Twice weekly, second half-year.*
Mathematical Astronomy. *Three times weekly, first half-year; twice weekly, second half-year.*
Higher Plane Curves. *Twice weekly, through the year.*
Conic Sections. *Twice weekly, through the year.*

Dr. Craig:
Theoretical Dynamics. *Twice weekly, first half-year.*
Mathematical Theory of Sound. *Three times weekly, first half-year.*
Elliptic Functions. *Three times weekly, first half-year.*
Theory of Functions. *Three times weekly, second half-year.*
Partial Differential Equations. *Twice weekly, second half-year.*
Theory of Elasticity. *Twice weekly, second half-year.*
Spherical Harmonics and Lamé's Functions. *Three times weekly, second half-year.*

Dr. Franklin:
Mechanics. *Three times weekly, through the year.*
Total Differential Equations. *Twice weekly, through the year.*
Determinants and Theory of Equations. *Three times weekly, first half-year.*
Solid Analytic Geometry. *Three times weekly, second half-year.*
Differential and Integral Calculus. *Three times weekly, through the year.*

Mr. C. S. Peirce:
Probabilities. *Twice weekly, second half-year.*

List of Papers read at the Mathematical Society.

G. **Bissing.**—On the degeneration of unicursal curves; a note on developable surfaces; unicursal curves in *n*-flat space; on curvature in *n*-flat space.

T. **Craig.**—On a certain class of transcendental functions.

E. W. **Davis.**—Some remarks on unicursal curves.

W. P. **Durfee.**—A note on the divisibility of numbers; on the number of substitutions of *n* letters which leave *k* of them unaltered.

G. S. **Ely.**—A note on partitions.

F. **Franklin.**—An elementary demonstration of Stirling's theorem; two notes.

A. S. **Hathaway.**—A demonstration of a theorem of Clebsch; the reduction of quadratic forms to sums of squares; on a form for the residues of composite moduli; a note on cycles.

C. S. **Peirce.**—On the mode of representing negative quantity in the logic of relatives.

W. E. **Story.**—On the intersection of linear and quadratic loci; a symbolical demonstration of Taylor's theorem; on a system of straight lines determined by two given lines; a note on ruled surfaces; on the equations which determine the directions of the axes of a quadric surface.

J. J. **Sylvester.**—The relation of minor determinants of products to minors of the factors.

Four numbers making the sixth volume of the American Journal of Mathematics have been issued during the academic year and the first number of the seventh volume is now in press.

PHYSICS.

PROGRAMME FOR 1884-85.

I. Advanced Course.

Professor Rowland:

Electricity and Magnetism.

Four lectures weekly.

Meetings for the Discussion of Current Literature.

Weekly.

Associate Professor Craig:

Analytic Mechanics.

Three times weekly, first half-year.

Hydrodynamics.

Three times weekly, second half-year.

Partial Differential Equations.

Twice weekly, second half-year.

Dr. Kimball:

A course of lectures adapted to the wants of those who have already taken the equivalent of the undergraduate course in General Physics, and who wish to continue their studies in Physics, while making other subjects their principal study.

Lectures weekly.

Courses of Selected Readings in Physics by the students with examinations.

Heretofore these have embraced selections from the following works, one from each group being requisite:

Sound: Helmholtz.

Heat: Maxwell, Wüllner, Verdet, Tyndall.

Electricity and Magnetism: Jenkin, Wüllner, Verdet.

Light: Wüllner, Lloyd, Daguin, Jamin, Verdet.

Conservation of Energy: Youmans, and others.

Dr. Franklin:

Problems in Mechanics.

Twice weekly, through the year.

(All special students in Physics are expected to attend this course).

II. Special Course on Molecular Dynamics by Sir Wm. Thomson.

Sir William Thomson, D. C. L., F. R. S L & E., etc., Professor of Physics in the University of Glasgow, will deliver in October next, a course of eighteen lectures on *Molecular Dynamics*.

An introductory lecture will be given on Wednesday, October 1. The other lectures will follow on consecutive days.

Professors and students of physics from other institutions are invited to attend and arrangements will be made by which they may easily obtain temporary lodgings, provided an early intimation is received of their intention to come. A registration fee of $5 will be required from such persons as follow the course, unless they are in other ways connected with this university.

III. Annual Course of Instruction for Undergraduates in General Physics.

This course will embrace experimental lectures, recitations, and examinations, five times a week throughout the year, with one half-day each week given to laboratory work. The subjects taken up will include Mechanics, Acoustics, Optics, Light, Heat, Electricity, and Magnetism.

This course should precede the study of Chemistry and Biology. A knowledge of Plane Trigonometry is essential for admission to it.

IV. Laboratory Work.

The Physical Laboratory is furnished with apparatus purchased from the best European and American makers, selected with special reference to investigations, and especially valuable for researches in electricity, magnetism, light, and heat. The laboratory will be open for work, daily through the year.

Note.—Candidates for the degree of Ph. D., who take Physics as a principal subject will be expected to attend Professor Rowland's lectures for at least two years; to work not less than two years in the laboratory or to show such attainments in the mathematical theories of Physics as may be regarded as an equivalent; to exhibit a familiarity with a selected group of subjects, such as are treated by the following authors:

History: Poggendorff, Grant (History of Physical Astronomy);

Mechanics: Kirchhoff, Thomson & Tait, Poisson, Duhamel, Jacobi, Peirce, Resal, Routh, Newton, and (on special topics) Riemann, Beer, and Lamé;

Sound: Rayleigh, Helmholtz;

Optics: Fresnel (special memoirs), Billet, Verdet, Gauss (Dioptrische Untersuchungen), Young, Helmholtz (Physiologische Optik);

Heat: Clausius, Rankine, Verdet, Rühlmann, Briot, Fourier;

Electricity and Magnetism: Maxwell (complete treatise), Faraday, Wiedemann, Mascart, De la Rive, Thomson (papers on Electricity and Magnetism).

Such candidates will also be required to present a thesis upon some subject in that branch of Physics upon which they have been especially engaged.

WORK OF THE PAST YEAR, 1883-84.

The rooms devoted to the Physical Laboratory have been open daily for the prosecution of advanced study and research, under the direction of Professor Rowland and Dr. Hastings.

During the year original investigations in the following subjects have been carried on:

On the photography of the spectrum by the concave grating.
On the variation of the magnetic permeability with change of temperature.
On the distribution of heat in the solar spectrum.
On the determination of the B.A unit of electrical resistance in absolute measure.
On the determination of the specific resistance of mercury.

Experiments have been carried on, under the direction of Professor Rowland, with an appropriation from the government of the United States, with the view to aid in establishing an international unit of electrical resistance.

Advanced students have also taken part in meetings weekly, for the reading and discussion of the current physical journals.

Lectures have been given by Professor Rowland on Thermodynamics, Heat Conduction, and Physical Optics, four times weekly through the year.

The work of a part of the students has been guided by Dr. Hastings. The major course has included lectures, weekly through the year, and daily work in the laboratory, especially on Wednesdays. The minor course in General Physics has included instruction daily through the year in Elementary Mechanics, Acoustics, Heat, Magnetism, Electricity, and Light, and a weekly exercise in the laboratory under Dr. Hastings and Mr. Reid.

CHEMISTRY

AND MINERALOGY.

PROGRAMME FOR 1884-5.

The courses in Chemistry are intended to meet the wants (1) of graduates who make Chemistry their specialty, or who select it as one of their subordinate subjects for the degree of Doctor of Philosophy; (2) of undergraduate students who study Chemistry for general training; (3) of special students who for good reasons have neither received a bachelor's degree nor matriculated at this University. The first and second years' courses are designed mainly for undergraduates, though graduates and special students who have not done an equivalent amount of work will be required to follow such portions of these courses as may seem desirable.

I. Advanced Work.

1. Laboratory Work.

Most of the work of advanced students is carried on in the laboratory, which will be open to them daily, except Saturday, from 9 a. m. until 5 p. m. The work, which will consist in making difficult and typical preparations and in carrying out investigations on assigned topics, will be wholly under the direction of Professor Remsen.

2. General Lectures. (By Professor Remsen).

Advanced topics will be treated in lectures which will be given two or three times a week during the first half-year. These will be supplementary to the courses in general chemistry given during the first two years. The special topics will be changed each year. This year the course will be supplementary to the lectures on the Chemistry of the Compounds of Carbon.

3. Historical Lectures.

During the second half-year there will be a course of about twenty lectures on historical topics selected and assigned by Professor Remsen to Fellows and other advanced workers in the chemical laboratory.

This work, while serving to familiarize students with chemical literature, is intended also to aid them in acquiring the art of presenting subjects in the form of lectures before audiences. All those who look forward to the career of teachers of chemistry will be required to take active part in the exercises.

4. Journal Meetings.

The instructors and advanced students will meet twice a week for the purpose of hearing reports on the articles contained in the current journals of chemistry.

The reports are furnished in turn by all who attend the meetings. All the principal chemical journals are read and reported upon.

II. First Year's Course.

This consists of laboratory work and lectures or recitations.

1st Half-Year: Introduction to General Chemistry.
Lectures and examinations daily except Saturday (by Professor Remsen).

Laboratory Work
Three times weekly, laboratory open from 1 *to* 4 *p. m., Monday, Tuesday, and Thursday.* Work under the direction of Professor Remsen, Associate-Professor Morse, and Dr. Keiser.

2nd Half-Year: General Chemistry.
Conversational exercises supplementary to the course of the first half-year; *three times weekly* (by Associate-Professor Morse).

Laboratory Work.
As above, continued.

Mineralogy.
Introduction to Crystallography and Descriptive Mineralogy; *twice weekly* (by Dr. Williams).

III. Second Year's Course.

The second year's course is a continuation of that just described; together they form what is known as the Major Course.

1st Half-Year: Analytical Chemistry.
Lectures and examinations four times weekly (by Associate-Professor Morse).

Descriptive Mineralogy.
Once weekly (by Dr. Williams).

Laboratory Work.
Daily except Saturday, 2–5 *p. m.* (under the direction of Professor Remsen and Associate-Professor Morse).

2nd Half-Year: Chemistry of the Compounds of Carbon.
Lectures and examinations daily except Saturday, (by Professor Remsen).
Laboratory Work.
As above, continued.

IV. Applied Chemistry.

Opportunity will be offered for work in Applied Chemistry in almost any direction. Some instruction will be given in the assaying of ores. The object of this work is not to make assayers in the narrow sense of the word, nor mere analysts of certain products, but to afford the thoroughly trained chemist an opportunity to familiarize himself with some of the more important applications of his science.

V. Mineralogy and Geology.

In addition to the elementary instruction in Mineralogy included in the regular chemical courses as above described, Dr. George H. Williams will give a course in general Inorganic Geology extending through the first half-year; and special laboratory instruction in Mineralogy and Petrography throughout the year.

WORK OF THE PAST YEAR, 1883-84.

The Chemical Laboratory is a new building which covers an area of about 50 by 100 feet and has three full stories and a basement. In the basement are the necessary conveniences for assaying and other furnace operations. On the next floor there are large rooms devoted mainly to qualitative and quantitative analysis. On the second floor, are the rooms for research work, those of the director, the library, and a lecture room for General Chemistry. On the third floor, are rooms for the chemical and mineralogical collections, a working and lecture-room for mineralogy, and a second lecture-room for chemistry. The laboratory will conveniently accommodate about ninety working students.

Advanced students have been engaged daily in the laboratory in prosecuting such work as seemed best adapted to the purposes of each. Those who have completed the full courses in General Chemistry, including from two to three years' work in qualitative and quantitative analysis and about a year's work in making difficult and instructive preparations, were encouraged to undertake the solution of original problems.

The following investigations have been completed during the year. Others are in progress.

A contribution to the history of active oxygen.
The action of heat on ethylene.
On the chemical conduct of the sulphinide obtained by oxidizing α-naphthalene-sulphamide.
The effect of light on fermentation.
The relative stability of halogen derivatives of carbon compounds.

The results of these investigations have either been already published or will soon appear in the *American Chemical Journal.* Some of them have been read before the Johns Hopkins Scientific Association at its regular meetings.

The Fellows and other advanced students have met the instructors twice a week during the year for the purpose of keeping abreast of the current chemical literature. All the important journals have been carefully read, and full reports of the various articles have been made.

These students have been often called upon to treat important chemical questions in a broad way, going to the original sources and presenting the results in a complete form. In most cases the topics so investigated have been connected with the experimental work going on at the time; but other questions also have been elaborated in this way which bore less directly on the current studies. In several cases carefully written reports of the results obtained have been prepared. The excellent library of chemical books and journals which is accessible to the students in the laboratory, at all reasonable hours, has greatly facilitated the execution of this very desirable literary work.

At the beginning of the year subjects were assigned to the Fellows and others for the preparation of lectures on various chemical topics treated historically; and sixteen such lectures were the result. These were prepared from a careful study of the original articles in the journals, and were not borrowed from books on the history of chemistry. Full abstracts of these lectures, furnished with complete references to the articles consulted, are to be prepared and preserved in the chemical library. The lectures given were as follows:

Two by Mr. D. T. Day on "The History of the Halogens";
Two by Mr. H. N. Stokes on "The History of Oxygen";
Two by Mr. E. H. Keiser on "The Chemistry of Iron Historically Considered";
Two by Dr. J. R. Duggan on "The History of the Azo- and Diazo-Compounds";
One by Dr. G. H. Williams on "The Relation between Crystalline Form and Chemical Constitution";
One by Mr. A. G. Palmer on "The History of Benzene";
One by Mr. H. W. Hillyer on "Stas's Work on Atomic Weights";
One by Mr. J. E. Talmage on "The History of the Alkali Metals";
Two by Dr. Morse on "The History of Phosphorus";
Two by Professor Remsen on "The Basicity of Acids."

In addition, the work of the year has consisted of the courses below mentioned:

Laboratory Work for undergraduates through the entire year, conducted by Professor Remsen and Dr. Morse.

Lectures by Professor Remsen:
 General Chemistry (Non-Metals), *five times weekly, first half-year.*
 Chemistry of the Compounds of Carbon, *five times weekly, second half-year.*

Courses by Dr. Morse:
 Analytical Chemistry, *four times weekly, first half-year.*
 General Chemistry (Non-Metals), *five times weekly, second half-year.*

Courses by Dr. Williams:
 Practical exercises in Mineralogy and Petrography, through the entire year.
 Mineralogy, *three times weekly, first half-year.*
 Geology, *three times weekly, second half-year.*

Six numbers of the American Chemical Journal have appeared within the year. These are Nos. 3, 4, 5, 6 of Vol. V, and Nos. 1 and 2 of Vol. VI.

BIOLOGY.

PROGRAMME FOR 1884-85.

I. Collegiate Instruction.

This is designed especially for undergraduate students, but graduate students who have not had a thorough preliminary training will be required to follow the instruction in those subjects of the college course in which they are found to be deficient, before they will be permitted to undertake advanced biological studies or engage in original research.

First Year (Minor) Course.

This has been planned to meet the needs (1) of those who intend ultimately to take up some one branch of Biology (Zoölogy, Physiology, or Botany) for special study; (2) of students, graduate or undergraduate, who expect later to study medicine, but meanwhile desire, as a valuable preparation, to obtain some general knowledge of the phenomena, laws, and conditions of life; (3) of those who desire, as a part of their general college training, some acquaintance with the methods of modern experimental and observational science, and select Biology as a subject of study with that end in view.

The course consists of five lectures or recitations weekly throughout the academic year, with laboratory work. The laboratory work takes the place of the greater part of the outside reading required in connection with most other undergraduate courses in the university. The following subjects form together the year's work.

1. General Biology.

Three lectures or recitations weekly from the commencement of the session until the middle of April.

Attention is directed to the broad characteristic phenomena of life and living things rather than to the minutiæ of descriptive Botany or Zoölogy, or the character of orders, genera, and species. In the laboratory the student learns how to observe, how to verify and describe what he observes, how to dissect, and how to use a microscope; he examines selected vegetable and animal types from unicellular organisms, as the yeast-plant and Amœba, to the fern and the flowering-plant on one side and the crayfish and a mammal on the other. In the lecture room attention is mainly given to the fundamental biological facts and laws which the particular plant or animal under consideration is fitted to illustrate, the object being rather to give the student an idea of what is meant by the terms living thing, plant, animal, tissue differentiation, life history, organ, function, etc., than to teach him the elements of Botany and Comparative Anatomy as commonly understood. The organisms studied are Torula, Protococcus, Amœba, Bacteria, Penicillium, Mucor, Spirogyra, Nitella, a moss, a fern, a flowering-plant, Infusoria, Hydra, starfish, earthworm, crayfish, clam, squid, cartilaginous fish, frog, terrapin, pigeon, and rat; so that at the close of the course the student has a practical knowledge of a typical example from each of the main divisions of plants and animals, on which to base further reading.

2. The Embryology of the Chick.

Three lectures or recitations weekly from the middle of April until the close of the session.

In this course the student, who has already in his General Biology observed the natural arrangement of animals and plants in diverging series ranging from a simple bit of living matter to highly complicated organisms, studies the individual development of one of the higher animals, from its start as an almost formless bit of living matter to its final highly complex structure. The increasing differentiation of tissues and organs which he has noted as higher and higher plants and animals were dissected, he now sees exemplified by the chick embryo in different stages of development. At the same time a good foundation is laid for subsequent advanced study in Vertebrate Morphology.

3. Osteology, Human and Comparative.

Two lectures or recitations weekly until the middle of April, with practical study on selected skeletons.

The student begins with the human skeleton, which, as the most minutely and accurately described of all conveniently accessible animal structures, is well fitted to train him to observe closely and accurately. He then studies a skeleton from each of the chief orders of the Mammalia and two or three from each of the remaining main groups of Vertebrata.

4. Plant Analysis.

Practical instruction twice weekly from the middle of April until the close of the session.

The student is taught how to collect and preserve plants; and by the analysis of a number of flowering plants under the direction of his teacher, gets a good introduction to the terminology of descriptive botany, and learns how to use a botanical key for the recognition of species.

Second Year (Major) Course.

This is designed for those who, having completed the above minor course, desire to proceed farther with biological studies. Ultimately the second year's work in biology will be, at the choice of the student, one of three courses; in the first of these Animal Physiology will be the dominant study; in the second, Animal Morphology; in the third, Botany; for the present a choice is only offered between the first and second of the three.

[To complete his major course a student must, after finishing his minor, take either 1, 2, and 3, of the subjects below named, or 2, 3, and 4. The former combination is especially fitted for those who intend afterwards to study medicine].

1. Mammalian Anatomy.

Twice weekly, until Christmas.

In connection with this course the student dissects one of the higher mammals with all the minuteness with which the human body is dissected in a medical school. He thus not merely learns how to dissect thoroughly, but acquires a knowledge of the names, general distribution and structure of nearly all the muscles, nerves, vessels, and viscera, and becomes fitted to take up profitably the professional study of the details of descriptive and regional Human Anatomy, and so saves much time when he afterwards enters a medical school.

2. Animal Physiology and Histology.

Three lectures or recitations weekly during the year.

This course is designed to give the student a good knowledge of the healthy properties and mode of working of the various tissues and organs of the higher animals, man included; also to give him a good knowledge of their microscopic structure. In the laboratory each student examines for himself the histology of each organ and tissue, and thus learns the use of reagents and embedding materials, the methods of mounting specimens, etc.; he also studies practically the composition of the more important organs and tissues, the chemistry of digestion, the fundamental properties of living muscles and nerves, the beat of the heart, the phenomena of reflex action, etc. Important physiological facts, which require special skill for their exhibition or the employment of especially delicate instruments, are demonstrated to the class. There will be, as a rule, one such demonstration weekly.

3. **Elements of Zoölogy.**

Two lectures or recitations weekly from Christmas until the end of the academic year.

A systematic course of lectures on the structure, relationships, and classification of animals. In the laboratory the student will dissect a number of forms selected to supplement the types studied in the General Biology course.

4. **Marine Laboratory.**

At least two months' study at the marine laboratory of the University between June 1st and August 31st.

This may be taken in one year or a month may be taken in each of two consecutive years.

II. University Instruction and Opportunities.

This is designed for graduates who have already such a knowledge of Biology as might be obtained by following the collegiate major course in that subject, and for others who, although not graduates, satisfy the university authorities that they are competent to undertake advanced work. In the university courses but little of the teaching is given by formal lectures; the instructors come into close daily contact with the students, supervise their work, direct their researches, and advise as to their reading.

1. **Animal Physiology.**

The new biological laboratory opened last October, has been especially constructed with reference to providing opportunity for advanced work in experimental physiology. The collection of physiological instruments belonging to the University is unusually large and complete and is yearly added to,—the Trustees providing an annual sum for the purchase of instruments wanted for any particular investigation, or which for other reasons it is desirable to have in the laboratory. There is also a well-fitted-up workshop in the laboratory in which a skilled mechanic is kept constantly at work repairing and constructing instruments. The laboratory contains two large rooms for general advanced work in animal physiology, in addition to others specially designed for work with the spectroscope, with the myograph, for electro-physiological researches, and for physiological chemistry.

2. **Animal Histology.**

The laboratory contains a special room constructed for advanced histological work, and well supplied with apparatus and reagents. There is also a room for micro-photography.

3. **Animal Morphology.**

Rooms for advanced work in this subject are also contained in the laboratory and a course of advanced lectures will be given by Dr. Brooks. The chief advanced study in animal morphology is however carried on at the Marine Laboratory, open at the seaside from the beginning of June until the end of August, under the direction of Dr. Brooks. The Marine Laboratory possesses a steam launch, and is supplied with the necessary dredges, boats, aquaria, microscopes, etc.

4. **Physiological Psychology.**

During the academic year a course of lectures, combined with laboratory work, will be given by Dr. G. Stanley Hall, in connection with the psychological courses of instruction in the university.

5. **Lectures.**

Short advanced courses of lectures are given from time to time on selected physiological and morphological subjects.

6. **Journal Club.**

A Journal Club, composed of the instructors and advanced students, meets weekly for the reading and discussion of recent biological publications.

7. **Library Facilities.**

The laboratory contains a library supplied with standard biological works and complete sets of the more important journals. There is also a special collection of books which have been brought together in connection with researches carried on in the laboratory. An effort is always made to procure for anyone engaged in a particular investigation all publications bearing on his work but not easily accessible, as graduation theses, occasional publications from laboratories in Europe and elsewhere, etc. The biological library receives regularly about forty biological periodicals, including all the important physiological and morphological journals in English, French, German, and Italian.

The general library of the University receives all the chief journals of general science, and the transactions of all the leading learned societies of the world.

The Library of the Peabody Institute, within five minutes' walk of the University, contains complete sets of many of the chief biological journals, of the proceedings of learned societies, and other works of reference.

In the library of the Medical and Chirurgical Faculty of Maryland, a very large number of medical periodicals is accessible to members of the University.

The proximity of Washington is of special value to advanced students of physiology. The Library of the Army Medical Museum in that city contains an almost unrivalled store of physiological works which are available under conditions favorable to study.

8. **Publication.**

In connection with the biological laboratory there is published a journal ("*Studies from the Biological Laboratory*") which contains the results of most of the researches carried out in the laboratory; a ready means of publication for original work is thus secured. The *University Circulars*, which appear at brief intervals throughout the year, are available for preliminary statements, securing priority for discoveries while more detailed accounts are in course of publication.

III. Naturalists' Field Club.

This was organized by members of the University, but includes in its list of members other residents of Baltimore interested in Natural History. The club works in three sections—Geology and Mineralogy, Zoölogy, Botany. Each section elects its own officers and arranges for its own field excursions and its own meetings. There are also monthly meetings of the whole club, when the chairmen of the different sections report progress and an address on some topic of Natural History is given by one of the members.

The mineralogical collections of the club are preserved in the Chemical Laboratory; the botanical and zoölogical in the Museum of the Biological Laboratory.

WORK OF THE PAST YEAR, 1883-84.

I. Laboratory Work.

The Biological Laboratory has been open for eight hours daily during the year, for the prosecution of advanced study and research and for courses of practical instruction in connection with classes.

During the year original investigations, the results of which either have been or soon will be published, have been made in the following subjects:

The nature of the process of the coagulation of blood. The chemical composition of the blood of the Terrapin. The influence of various salts and other substances on the contraction of the arterioles. The suction-pump action of the heart. The influence of sudden variations of arterial pressure on the rhythm of the heart. The action of carbolic acid on the heart and its antagonism by atropin. The influence of convallarin and convallamarin on the heart. The anatomy of Nemertians. The development and metamorphosis of various insects. The development and histology of Salpa. The histology of Amiurus.

In connection with the regular class instruction, first year students thoroughly studied a number of typical fungi, green plants, and animals; the skeletons of about twenty selected vertebrates; and the development of the chick in the egg. In the spring there were a few practical lessons in the elements of Systematic and Descriptive Botany.

Second year students worked at the histology of the tissues and organs of the higher vertebrata (especially man); the physiological properties and functions of the tissues and organs; the physiology of digestion; the chemistry of bile, urine, etc. The stock of physiological apparatus belonging to the University being unusually large, and including several duplicates of all the more frequently used instruments, each student in the class of Animal Physiology had the opportunity and was required to perform for himself all the really fundamental physiological experiments, save such as required some special skill or the use of very delicate apparatus; these were demonstrated to the class. The cat was also thoroughly dissected by the second year students.

II. Advanced Instruction.

A course of twenty-three advanced lectures was given as follows:

Four lectures by Professor Martin on "The Causes of Chemical Degradation in the Animal Body."

Four lectures by Mr. W. H. Howell on "The Consumption of Matter by the Animal Body under various conditions."

Two lectures by Mr. F. S. Lee on "The Formation of Fat in the Animal Body."

Four lectures by Mr. L. T. Stevens on "The Relative Value of Various Foodstuffs."

One lecture by Mr. H. F. Nachtrieb on "The Physiology of Hunger and Thirst."

Three lectures by Mr. Otto Lugger on "The Metamorphosis of Insects."

Two lectures by Mr. H. L. Osborn on "The Embryology of Insects."

Three lectures by Mr. H. W. Conn on "The Relationship between Vertebrates and Invertebrates.

Dr. W. K. Brooks gave a course of about thirty-five lectures on the Morphology of the Crustacea.

Professor W. Trelease, of the University of Wisconsin, delivered in January fourteen lectures on "Vegetable Physiology." He also delivered in Hopkins Hall four lectures on "The Fertilization of Flowers."

Most of the advanced work, however, was carried on individually, and not in class; each worker taking up some special topic for study under the immediate direction of some one of the instructors. In addition to the original researches already enumerated, certain graduate students have in this manner carried on advanced study in various directions.

Students engaged in this kind of study (which forms a stepping-stone between class-work and original research), are usually given some important original article, and shown how to repeat and verify for themselves (and criticise, if necessary) the experiments and results described in it. By studying and repeating the original work of others they learn the methods of biological investigation, and are thus trained to plan and carry out researches themselves. In connection with this work, students are also taught how to hunt up and utilize the bibliography of a subject.

III. Class Instruction.

Courses of lectures for undergraduates were given as follows:

Osteology, *twice weekly, through the year.*

Mammalian Anatomy, *twice weekly, until Christmas.*

Animal Physiology and Histology, *three times weekly, through the year.*

General Biology, *three times weekly, until the middle of April.*

Embryology of the Chick, *three times weekly, from the middle of April until the close of the session.*

Plant Analysis, *twice weekly, in May.*

IV. Marine Laboratory.

During the summer of 1883, the seaside Zoölogical Laboratory for the study of forms of marine life, was open at Hampton, Va., from May 1 until September 29.

The advanced work included original investigations on the following subjects:

The anatomy and development of barnacles, the anatomy and development of crabs, the histology of Eudendrium, the anatomy and development of Balanoglossus, the development of the oyster, the anatomy of Lingula, the protozoea stage of crabs, the development of Annelids, the anatomy and development of Chrysaora, the origin of the eggs of hybrids and tunicates, the function of the semi-circular canals of sharks, and the general zoölogy of the Hydro-Medusae.

V. Publications.

Number 1 of the third volume of "*Studies from the Biological Laboratory*" was published in March. It contains:

I. Significance of the larval skin of Decapods. By H. W. Conn. With two plates.
II. Life history of Thalassema. (Abstract.) By H. W. Conn. With one plate.
III. Of the Gill in some forms of prosobranchiate Mollusca. By H. L. Osborn. With three plates.

Number 2 of Volume III is in press.

Articles by various members of the biological department have also been published in the *University Circulars*, in the *Journal of Physiology*, and in the *Zoölogischer Anzeiger*. Abstracts of two researches have been printed in the Proceedings of the Royal Society of London, and will shortly appear in full in the "Philosophical Transactions."

The report of the Oyster Commission of the State of Maryland, prepared by Dr. W. K Brooks, Chairman of the Commission, and embodying the results of his prolonged investigations at the Marine Laboratory upon the propagation of the American Oyster, was issued in February.

ANCIENT AND MODERN LANGUAGES.

PROGRAMMES FOR 1884-85.

GREEK.

I. Greek Seminary.

Professor Gildersleeve will conduct the Greek Seminary, the plan of which is based on the continuous study of some leading author or some special department of literature.

The Seminary consists of the Director, Fellows, and Scholars, and such advanced students, to the number of six, as shall satisfy the Director of their fitness for an active participation in the work, by an essay, a critical exercise, or some similar test of attainments and capacity. All graduate students, however, may have the privilege of attending the course.

During the next academic year the study of *The Attic Orators* will constitute the chief occupation of the members. There will be two meetings a week during the entire session. Especial attention will be paid to the development of language and style and to the antique canons of aesthetic criticism. The rhetorical works of Dionysios of Halikarnassos will be studied in connexion with this course.

The student should possess the text of the orators (Teubner ed.). Blass's *Geschichte der Attischen Beredsamkeit* is an indispensable auxiliary. An effort will be made to have the seminary library fairly complete in the important works of reference for the study.

II. Advanced and Graduate Courses.

1. **Professor Gildersleeve** will also conduct a course of *Practical Exercises in Greek*, consisting chiefly in translation at dictation from Greek into English and English into Greek, two meetings a week, from the beginning of the session to the first of January. Advanced undergraduates will be admitted to this course upon the recommendation of their advisers.
2. Professor Gildersleeve will lecture on the *Syntax of the Moods and Tenses* once a week until January 1, and thereafter twice a week until April 1.
3. Professor Gildersleeve will lecture on the *Greek Lyric Poets*, with illustrative readings, once a week after January 1.
4. **Dr. Bloomfield** will give a course in the Comparative Grammar of Greek, during the first half-year.
5. Notices as to other courses are reserved.

III. New Testament Greek.

Mr. J. Rendel Harris will give the following courses:

1. Paleography, with especial reference to the Documents of the New Testament.
2. The Gospel of Mark, with an examination of the question as to the authenticity of the last twelve verses.
3. Portions of the Sub-Apostolic literature will be read and criticized, and in particular the second epistle of Clement and the "Teachings of the Twelve Apostles."
4. A short course will probably be given on some questions connected with Church History and the growth of Christian Institutions.

IV. Undergraduate Courses.

1. Isocrates, I, IV; Xenophon, *Hiero*.
   Three times weekly, first half-year. Dr. Spieker.
   Conferences on Greek History.
   Weekly, first half-year. Professor C. D. Morris.
2. Homer, *Iliad*, XVI, XVII; Euripides, *Hercules Furens*.
   Four times weekly, second half-year. Dr. Spieker.
3. Plato, *Gorgias*.
   Four times weekly, first half-year. Professor C. D. Morris.
4. Aeschylus, *Septem c. Thebas;* Euripides, *Iphig. in Taur.*
   Three times weekly, second half-year. Professor C. D. Morris.
   Conferences on Greek Grammar.
   Weekly, second half-year. Professor Gildersleeve.
5. Prose Composition.
   Weekly exercises in connection with each of the above courses.

Private Reading. Students having the time are encouraged to pursue parallel courses of private reading under the direction of the instructor. Those who pass examinations on such work will be able to complete their courses in shorter time than otherwise. Examinations on the following books will be provided for 1884-5:

1a. Merry's *Selections from Herodotus.*
2a. Plutarch, *Themistocles*, *Cicero.*
3a. Homer, *Odyssey.* XXI–XXIV.
4a. Xenophon, *Oeconomicus.*

Note.—The work provided for subsequent years will be arranged on a similar scheme, although the books offered will be different. Examinations on the courses in Private Reading will be held at the end of each half-year. Class courses 1 and 2 are to be taken as the first year's work, with 1*a* and 2*a* of Private Reading. The second year's work will consist of 3 and 4, with 3*a* and 4*a* of Private Reading. Should any student be unable to do the Private Reading in connection with his class work, he may take the examination on Private Readings or extra courses of class work in a subsequent year. One course of class work is in all cases considered the equivalent of two courses of parallel reading.

Dr. A. Emerson will conduct courses in Classical Archæology through the year, for graduate as well as undergraduate students.

LATIN.

I. Latin Seminary.

Dr. Warren will conduct the Latin Seminary. The study of *Roman Satire* will form the chief occupation of the members during the next academic year. There will be two meetings a week throughout the year one of which will be devoted to critical interpretation and the other to auxiliary studies, and to the discussion of papers presented by members of the Seminary. It i probable that during the first half of the year more particula attention will be paid to Horace and Lucilius, and in the latte half to Juvenal, and in a less degree to Persius.

Students are advised to provide themselves in advance with Keller an Holder's Editio Minor of Horace (Leipzig, 1878) and Schütz's edition Horace's Satires (Berlin, 1881); Otto Jahn's edition of Juvenal with th Scholia, (Berlin, 1851), or Mayor's Thirteen Satires of Juvenal with a commentary (2 vol., Macmillan, 1878 and 1880); and with Lachmann's edition Lucilius (Berlin, 1876 with the Index Lucilianus of Harder, Berlin, 1878 or the edition of Lucian Mueller (Leipzig, 1872).

A good reading knowledge of German is very essential for the successfu prosecution of the course.

BIOLOGY.

PROGRAMME FOR 1884-85.

I. Collegiate Instruction.

This is designed especially for undergraduate students, but graduate students who have not had a thorough preliminary training will be required to follow the instruction in those subjects of the college course in which they are found to be deficient, before they will be permitted to undertake advanced biological studies or engage in original research.

First Year (Minor) Course.

This has been planned to meet the needs (1) of those who intend ultimately to take up some one branch of Biology (Zoölogy, Physiology, or Botany) for special study; (2) of students, graduate or undergraduate, who expect later to study medicine, but meanwhile desire, as a valuable preparation, to obtain some general knowledge of the phenomena, laws, and conditions of life; (3) of those who desire, as a part of their general college training, some acquaintance with the methods of modern experimental and observational science, and select Biology as a subject of study with that end in view.

The course consists of five lectures or recitations weekly throughout the academic year, with laboratory work. The laboratory work takes the place of the greater part of the outside reading required in connection with most other undergraduate courses in the university. The following subjects form together the year's work.

1. General Biology.

Three lectures or recitations weekly from the commencement of the session until the middle of April.

Attention is directed to the broad characteristic phenomena of life and living things rather than to the minutiæ of descriptive Botany or Zoölogy, or the character of orders, genera, and species. In the laboratory the student learns how to observe, how to verify and describe what he observes, how to dissect, and how to use a microscope; he examines selected vegetable and animal types from unicellular organisms, as the yeast-plant and Amœba, to the fern and the flowering-plant on one side and the crayfish and a mammal on the other. In the lecture room attention is mainly given to the fundamental biological facts and laws which the particular plant or animal under consideration is fitted to illustrate, the object being rather to give the student an idea of what is meant by the terms living thing, plant, animal, tissue differentiation, life history, organ, function, etc., than to teach him the elements of Botany and Comparative Anatomy as commonly understood. The organisms studied are Torula, Protococcus, Amœba, Bacteria, Penicillium, Mucor, Spirogyra, Nitella, a moss, a fern, a flowering-plant, Infusoria, Hydra, starfish, earthworm, crayfish, clam, squid, cartilaginous fish, frog, terrapin, pigeon, and rat; so that at the close of the course the student has a practical knowledge of a typical example from each of the main divisions of plants and animals, on which to base further reading.

2. The Embryology of the Chick.

Three lectures or recitations weekly from the middle of April until the close of the session.

In this course the student, who has already in his General Biology observed the natural arrangement of animals and plants in diverging series ranging from a simple bit of living matter to highly complicated organisms, studies the individual development of one of the higher animals, from its start as an almost formless bit of living matter to its final highly complex structure. The increasing differentiation of tissues and organs which he has noted as higher and higher plants and animals were dissected, he now sees exemplified by the chick embryo in different stages of development. At the same time a good foundation is laid for subsequent advanced study in Vertebrate Morphology.

3. Osteology, Human and Comparative.

Two lectures or recitations weekly until the middle of April, with practical study on selected skeletons.

The student begins with the human skeleton, which, as the most minutely and accurately described of all conveniently accessible animal structures, is well fitted to train him to observe closely and accurately. He then studies a skeleton from each of the chief orders of the Mammalia and two or three from each of the remaining main groups of Vertebrata.

4. Plant Analysis.

Practical instruction twice weekly from the middle of April until the close of the session.

The student is taught how to collect and preserve plants; and by the analysis of a number of flowering plants under the direction of his teacher, gets a good introduction to the terminology of descriptive botany, and learns how to use a botanical key for the recognition of species.

Second Year (Major) Course.

This is designed for those who, having completed the above minor course, desire to proceed farther with biological studies. Ultimately the second year's work in biology will be, at the choice of the student, one of three courses; in the first of these Animal Physiology will be the dominant study; in the second, Animal Morphology; in the third, Botany; for the present a choice is only offered between the first and second of the three.

[To complete his major course a student must, after finishing his minor, take either 1, 2, and 3, of the subjects below named, or 2, 3, and 4. The former combination is especially fitted for those who intend afterwards to study medicine].

1. Mammalian Anatomy.

Twice weekly, until Christmas.

In connection with this course the student dissects one of the higher mammals with all the minuteness with which the human body is dissected in a medical school. He thus not merely learns how to dissect thoroughly, but acquires a knowledge of the names, general distribution and structure of nearly all the muscles, nerves, vessels, and viscera, and becomes fitted to take up profitably the professional study of the details of descriptive and regional Human Anatomy, and so saves much time when he afterwards enters a medical school.

2. Animal Physiology and Histology.

Three lectures or recitations weekly during the year.

This course is designed to give the student a good knowledge of the healthy properties and mode of working of the various tissues and organs of the higher animals, man included; also to give

GERMAN.

Knowledge of German is required in all courses of study which lead to graduation. Instruction is provided to meet the requirements of different classes of students, as follows:

Class for Beginners.

This class will meet three times weekly through the year. The text-books used will be Whitney's Grammar, and Reader (first twenty-four pages), and Ahn-Henn's Rudiments (first half), with short selections in prose. The course does not count as part of the requirements for graduation, but is simply an aid provided by the University for those who are not ready to enter class A. Attendance upon this class is restricted to undergraduate students.

Note 1.—Candidates for Class A may offer as an equivalent for the work of the beginner's class:

Grammar: Declension, gender, conjugation, and the simpler rules of syntax.

Reading: Whitney's reader, the first 24 pages, or Adler's reader, the prose pieces in the first and second sections, or equivalents. They must also be able to render at sight simple English sentences into German.

Class A.

This is commonly called the minor course. For admission to it, the student, whether collegiate or graduate, must possess the knowledge indicated above.

All undergraduates, except the classical students, are required to follow this course or to show that they have an equivalent knowledge of German. Classical students are also advised to pursue this study and will receive from the instructor such counsel as will aid them in doing so, and his certificate will be needed before they can fully satisfy the requirements for graduation.

There will be five class meetings, weekly, through the year.

Classics: Prose; Drama.
Twice weekly.

Miscellaneous Selections.
Weekly.

Prose Composition, with Whitney's Grammar.
Weekly.

Oral practice in German; based upon familiar readings and exercises.
Weekly.

Note 2.—Candidates who offer German in place of Greek for matriculation will be examined on the work of Class A or its equivalent.

Class B.

Students who have completed the work of Class A or an equivalent may take a second year's course or any part of it.

There will be five meetings weekly, as follows:

Reading of German Classics (continued.)
Twice weekly.

Prose Composition.
Weekly.

Lectures on the History of German Literature from the Reformation, with Kluge's Geschichte der deutschen Literatur and readings.
Weekly.

Middle High German; selections from the Nibelungen Lied, Gudrun, etc.; lectures on the chief Teutonic epic cycles, with illustrations.
Weekly.

Exercises in German style and syntax.
Monthly.

Exercises in German conversation.
Enrollment for these exercises is optional.

Note 3.—Graduate students who show their fitness for it, may join certain classes in B while still in A.

(Statements as to advanced courses are reserved).

ROMANCE LANGUAGES.

Knowledge of French is required in all courses of study that lead to graduation. Instruction is provided to meet the needs of different classes of students, as follows:

Class for Beginners.

This class will meet daily through the year. The text-books used will be Breymann's French Grammar, Chardenal's First French Course, together with the beginning of Knapp's French Readings. The course does not count as part of the requirements for graduation but is simply an aid provided by the university for those who are not ready to enter class A, for which the work here done is considered a sufficient preparation.

I. French: Class A.

(Course for a first year).

To enter this course both a written and an oral examination must be passed. Candidates will be required to have a thorough knowledge of Grammar forms, especially of the irregular verbs, to have read one hundred duodecimo pages of French Prose and to have translated twenty-five pages of English exercises into French. For the oral examination they are requested to offer the texts they have used in preparation.

1. Reading of Literary French.
   Selections from Guizot, Dumas *père*, Th. Gautier, Daudet, Victor Hugo. Knapp: *French Readings. Twice weekly.*
2. Historical Course.
   Montesquieu: *Grandeur et Décadence des Romains. Weekly.*
3. Scientific Course.
   Milne-Edwards: *Précis d'Histoire Naturelle;* Flammarion: *Merveilles du Ciel. Weekly.*
4. French Composition.
   Syntax, *first half-year;* Idioms, *second half-year. Weekly.*
5. Lectures.
   The lectures will discuss Victor Hugo, and the Romantic school; Théophile Gautier and the Naturalists; Guizot and the Modern Historians. *Fortnightly.* .

Opportunities for thorough training in French pronunciation and conversation will be given, a class meeting daily through the year.

II. French: Class B.

(Course for a second year).

Open only to those who have pursued the first year's course or its equivalent.

1. Lectures on French Philology, Phonetics, etc.
   Weekly.
2. Lectures on French Literature of the Middle Ages.
   Fortnightly, second half-year.
3. Middle French.
   Calvin, François de Sales, Montaigne, Satyre Ménippée, Brantôme, Rabelais, Des Périers, Marot, École de Ronsard, with lectures on sixteenth century Phonetics, Morphology and Syntax, accompanying the texts read. Darmesteter et Hatzfeld: *Morceaux Choisis. Twice weekly, first half-year.*

4. Old French.
   Les plus anciens monuments, St. Alexis, Roland, Chrestien de Troyes, Renart, Rose, Villehardoin, Joinville, Froissart. Bartsch: *Chrestomathie de l'Ancien Français. Twice weekly, second half-year.*
5. Classical French.
   Molière: *Le Misanthrope;* Corneille: *Le Cid;* Racine: *Phèdre. Weekly.*
6. Prose Composition.
   Gasc's Prose Composition, *first half-year;* Original Essays, *second half-year. Weekly.*

III. Special Courses in Italian and Spanish.

1. Italian:
   (*a*) *Literary Course.* Manzoni: *I Promessi Sposi;* Alfieri: *Abel;* Goldoni: *La Sposa Sagace, Gl' Innamorati;* Dante: *Inferno. Weekly.*
   (*b*) *Historical Course.* Machiavelli: *Le Istorie Fiorentine;* Sonzogno's *Storia della letteratura italiana. Weekly.*
   (*c*) *Grammar and Composition. Weekly.*
2. Spanish:
   Selections from "Fernan Caballero," José Selgas, Lafuente, Javier de Burgos, Juan Valero, Emilio Castelar. Knapp: *Spanish Readings; first half-year.* Calderon: *La Devocion de la Cruz; El Mágico Prodigioso;* Cervantes: *Don Quijote; second half-year. Twice weekly.*

IV. Advanced Courses in Romance Philology.

(For advanced students, and candidates for the degree of Ph. D. taking this subject).

Course 1:

(*a*) Old French Seminary.
Critical examination of the earliest monuments of the language, viz.: *La Cantilène de Sainte Eulalie, Passion du Christ, Vie de Saint Alexis. Weekly.*

(*b*) Langue d'oïl Dialects.
Lectures and practical exercises. *Weekly.*

(*c*) Comparative Phonology of the Romance Languages.
Lectures. *Weekly.*

(*d*) Catalan and Modern Provençal (first half-year), Wallachian (second half-year).
Weekly.

(*e*) The History of Romance Studies in Europe.
Lectures. *Weekly.*

Course 2:

(*a*) Old French.
Aucassin et Nicolète (Suchier's edition). *Weekly.*

(*b*) Old Provençal.
XIII and XIV Century Extracts. Bartsch: *Chrestomathie Provençale. Weekly.*

(*c*) French Phonetics of the Major Course.
Weekly.

(*d*) Italian, with special students.
Thrice weekly.

(*e*) Spanish, with special students.
Twice weekly.

(*f*) Portuguese.
Braga: *Antologia portugueza;* Camões: *Os Lusiadas. Weekly.*

(*g*) Ladinian.
Ulrich: *Rhätoromanische Chrestomathie,* (*II Theil.*). *Weekly, second half-year.*

WORK OF THE PAST YEAR, 1883-84.

I. Greek.

Under the direction of Professor Gildersleeve the advanced students of Greek have been organized into a Greek Seminary. According to the plan of the seminary the work of each year is concentrated on some leading author or some special department of literature. During the past year the work has been in the Greek historians.

In the seminary proper, which met twice a week during the academic year, select portions of Thukydides were interpreted in turn by the different members of the seminary, with lectures and illustrative papers by the Director and the students.

Among the subjects treated may be mentioned: The composition of the different parts of the history of Thukydides, the principles that regulate the introduction of the Thukydidean speeches, use of the passive and middle in Thukydides, Thukydidean compounds, use of ϑέρος and χειμών in Thukydides, oracles in Herodotos, conditional sentences in Herodotos, the tract de Republica Atheniensium.

The work of the seminary was supplemented by the lectures of the Director on Greek Historiography, illustrated by readings and by an analysis of the treatises of Dionysios of Halikarnassos on the style of Thukydides.

Besides the seminary course proper, Professor Gildersleeve delivered twenty-five lectures on the Theory of the Cases, conducted twenty-two exercises in translating at dictation from Greek into English, and English into Greek, and gave a course of fifteen lectures on Lucian.

Mr. Harris conducted a class-course in New Testament Greek, twice weekly, through the year, and gave two courses, one, of six lectures, on some New Methods of Textual Cricitism, and the other, of three lectures on the newly published tract entitled "The Teachings of the Apostles."

Dr. Emerson conducted two classes in Pausanias and Greek Inscriptions, each meeting weekly during the second half-year, and a class in Greek Classical Antiquities, meeting twice weekly during the first half-year.

A public course on Classical Archæology, comprising fifteen lectures, was given during the year. The course began with a lecture by Dr. Charles Waldstein, four lectures were given by Mr. J. T. Clarke, three by Mr. W. J. Stillman, six by Dr. A. Emerson, and a closing lecture by Professor Gildersleeve.

Additional courses were conducted during the year, by:

Professor C. D. Morris, in
  Thukydides, bk. VII, *four times weekly, first half-year.*
  Sophokles, *Philoctetes;* Aristophanes, *Ranae, four times weekly, second half-year.*
(This class has also read at sight the Apology and Crito of Plato and about one-half of the Antigone of Sophokles).
  Homer, *Iliad, once weekly, through the year.*

Dr. Spieker, in
  Lysias, *four times weekly, first half-year.*
  Homer, *Odyssey,* IX–XII; Euripides, *Alcestis, four times weekly, second half-year.*

Classes in Greek Prose Composition were also conducted by each of the instructors in connection with the courses above named.

Students have privately read for examination the following books:

Aeschylus, *Persae* (4).
Aristophanes, *Plutus* (1).
Demosthenes, *in Timocratem* (6).

Euripides, *Hippolytus* (4).
Herodotus, (Merry's Selections) (7).
Sophocles, *Electra* (1).
Xenophon, *Hellenica*, I, II, (7).

II. Latin.

The Latin Seminary under the direction of Dr. Warren, held two sessions a week throughout the year, the author selected for special study being Terence.

The plays of Terence were analyzed by the members of the seminary in turn, and a part of the Phormio and a very considerable portion of the Andria were made the subject of critical interpretation. Some twenty-five lectures were given by Dr. Warren on topics connected with the Roman drama, special attention being paid to the pre-Terentian literature, to the metres, and to the history of the text of Terence. Papers were presented embodying the results of special investigation by members of the seminary on the following subjects: on the Didascaliæ, on the peculiarities of G. Sulpicius Apollinaris as shown in the Periochae, on the position of adjectives and possessive pronouns relative to their substantives, on the critical value to be assigned to the citations of Terence found in Nonius Marcellus, on some striking differences between the metres of Plautus and Terence and those of Greek Comedy, on Terence's use of substantives as compared with that of Plautus, on the relative value of the different MSS. of Terence and their characteristic peculiarities, on Terence's use of the present participle, on the cases of ἀρχαϊσμός specially remarked upon by Donatus.

Dr. Warren also gave in the first half-year, a course of lectures on Latin Palæography, accompanied by practical exercises in reading fac-similes of manuscripts. In the latter half of the year, a similar course was given on Latin Epigraphy.

Additional courses have been conducted during the year, by:

Dr. Warren, in

Select Letters of Cicero and Pliny, Aulus Gellius, *three times weekly, first half-year.*
Juvenal, Select Satires, *three times weekly, second half-year.*
Horace, Select Satires, *once weekly, second half-year.*
Reading at Sight.

Professor C. D. Morris, in

Lucretius and Plautus, *seven hours in two weeks, first half-year.*
Tacitus, *four times weekly, second half-year.*
Reading at Sight.

Dr. Spieker, in

Livy, *four times weekly, first half-year.*
Horace, *three times weekly, second half-year.*

(Classes in Latin Prose Composition were also conducted by each of the instructors in connection with the courses above named).

Dr. Emerson, in

Classical Antiquities, *twice weekly, second half-year.*

Students have privately read for examination the following books.

Cicero, *de Senectute* (7); *de Amicitia* (7); *pro Roscio Amerino* (6); *de Finibus*, I, (4); *ad Atticum* (1); *de Natura Deorum*, I, (4); *Philippica*, II, (1).
Horace, *Epodes*, *Carmen Sæculare*, (6).
Livy, XXII, XXIII, (1).
Lucretius, V, (1).
Martial, (1).
Ovid, *Fasti*, I, II, (6).
Seneca, *de Tranquillitate Animi*, *Apocolocyntosis*, (1).
Suetonius, *Tiberius*, (2).
Tacitus, *Dialogus*, *Annals* III, (2).
Terence, *Andria*, (4).
Vergil, *Aeneid*, V, VI, (1).

III. Shemitic Languages.

The centre of Professor Haupt's work was the Old Testament. Hebrew was read two hours weekly, and was constantly referred to in all the other lectures on Arabic, Ethiopic, Assyrian, Sumero-Akkadian, and in the Assyriological exercises. With the exception of the last, all the courses were intended for beginners. Accordingly the instruction was given not in lectures but after the seminary method.

In *Hebrew*, the elementary difficulties having been overcome, portions of the Pentateuch were read and afterwards, at sight, some chapters from the books of Judges, Ruth, and Kings. The interpretation was confined chiefly to a thorough philological analysis. As a number of students who had studied Hebrew for several years took part in this elementary course, exegetical and critical problems were incidentally discussed, but attention was devoted mainly to a thorough training in the forms of the language. The grammar used was Dr. Mitchell's translation of Gesenius-Kautzsch.

The *Arabic* class, for want of a suitable text book in English, had to use Petermann's *Brevis linguae Arabicae grammatica.* After a preparatory training in the sounds and forms, the first chapters of Genesis (Saadia's Arabic version) were read and then the opening sura of the Qor'ân and an easy historical text without vowels. In the grammatical analysis the forms and the most important syntactical phenomena were thoroughly explained with a constant reference to the points of contact as well as of difference with the Hebrew language. In order to make the students acquainted with the use of the national Arabic lexica, Arabic definitions, chiefly from the Qamûs, were given and these served at the same time as exercises in reading at sight unpointed sentences. There were also composed by the students written exercises, conjugations of the more difficult irregular verbs and translations of syntactically interesting sentences from English into Arabic.

In *Ethiopic*, after some introductory lectures on the history of Abyssinia and the position of the Geez language in the cycle of the cognate idioms, the outlines of the grammar were given, and afterwards the reading and analysis of the *Narratiunculae de viris sanctis* in Dillmann's *Chrestomathia Aethiopica* were entered upon. The legends of St. Mark, Melchizedek, Abbâ Salâmâ, and Yared were read, and the beginning of the story of Macarius. In the grammatical interpretation the gutturals were especially treated of, with occasional references to Amharic and Tigriña and the close connection of the Geez language with Assyro-Babylonian was pointed out.

In *Assyrian* as well as in Ethiopic the lack of a convenient text book necessitated the dictating of the grammar. Thereupon the cuneiform Annals of Sardanapalus in Vol. V of Sir Henry Rawlinson's *Western Asia Inscriptions* were read: the account of the first five campaigns, the two against Egypt, the third against Baal of Tyre, the fourth against Achsheri (cf. Ahishahar 1 Chron. 7, 10) of Van, the fifth against Elam, and the beginning of the sixth against Shamash-shum-ukîn. Some written exercises with cuneiform paradigms of the Assyrian verbal inflexion, &c., were also composed.

In *Sumero-Akkadian* the great three-columned Syllabary in Haupt's *Keilschrifttexte* (Leipzig, 1881) was explained. The principal phenomena of the phonology of the pre-Shemitic idiom were discussed, the origin of some Akkadian ideographs from the archaic Mesopotamian picture writing traced and Akkadian words which have passed into Shemitic idioms especially into the language of the Old Testament were pointed out.

In the *Assyriological Exercises* for more advanced cuneiformists the sixth tablet of the Babylonian Nimrod Epic in Haupt's new edition (Leipzig, 1884) was read, and before this, select bilingual exorcisms, incantations, prayers, hymns and penitential psalms in parts II and III of Haupt's *Akkadian and Sumerian Texts* (Leipzig, 1881) and in Vol. IV of Sir Henry Rawlinson's *Cuneiform Inscriptions*, with special reference to Akkadian syntax and to the dialectical variations in the ancient Protochaldean idioms.

All the courses were two hours weekly, except Arabic and Ethiopic for each of which only a single hour weekly could be spared.

The proceedings of the *Shemitic Society* are given by the Recording Secretary, Dr. Arthur L. Frothingham Jr., in the April number of these *Circulars.*

IV. Sanskrit, etc.

Five courses in Sanskrit and a course in Comparative Philology were conducted by Dr. Bloomfield:

1. A beginner's class in Sanskrit, throughout the year. The most essential elements of the grammar were acquired in as short a time as possible, and then the student was brought face to face with the language, learning its structure and laws, not in the abstract, but in its living body. Five books of the *Nala* were read and thoroughly analyzed. The aim was either to prepare for the more advanced study of Indian philology in this university, or for private study, which is too difficult without such an introduction.

2. The advanced class in Sanskrit read during the greater part of the year the drama *Çakuntala*. The main effort was directed towards the Prâkrit, which was constantly analyzed and compared with the Sanskrit. Toward the end of the year the class read selections from the Brâmana literature.

3. Introduction into the Rig-Veda, throughout the year. After a short course of lectures, select hymns of this Veda were read. The language was studied from the point of view of the classical language; constant reference was made to the critical helps such as the *padapâṭha, anukramaṇī* and the metres.

4. During the first half of the session the Kauçika-sutra was read from the manuscripts and with the aid of a MS. commentary.

5. A practical exercise in Sanskrit Prose writing was conducted from Christmas to the end of the year, on the basis of Bühler's *Elementarcursus des Sanskrit.*

6. A course in the general principles of Comparative Philology was carried on throughout the year. It was introduced by ten lectures on the leading questions of Indo-European comparative grammar, (phonetic law and analogy, bi-syllabic roots, agglutination, etc.). For the rest of the year Prof. Whitney's "Language and the Study of Language" was made the basis of instruction, but this was constantly supplemented by lectures, which aimed to carry the subjects treated in the book up to the present day.

V. German.

Advanced courses were conducted as follows:

Gothic. *Weekly, first half-year.* DR. DIPPOLD.

Middle High German. *Twice weekly.* DR. DIPPOLD.

Deutsche Stilübungen and Essays. *Monthly.* MR. RADDATZ.

History of German Literature, consisting of lectures in German. *On alternate Saturdays.* DR. DIPPOLD.

Lectures on The Beast Epic and Middle Low German were also given, weekly, during the first half-year, by DR. GERBER.

The undergraduate classes were conducted by Dr. Dippold, with Mr. Raddatz in charge of the classes in Prose Composition.

In the first year's course Goethe's Egmont, Schiller's Maria Stuart, and Selections from Erler's Deutsche Geschichte, and from Scientific Prose were read. The first section read further Lessing's Minna von Barnhelm; and the second, Schiller's Wallenstein.

In the second year's course Goethe's Hermann and Dorothea, Faust, selections from Wilhelm Meister, and Lessing's Nathan were read; with the addition of sight readings from Emilia Galotti.

There were weekly exercises in Prose Composition in both the first and second year's courses.

Dr. Lehmann conducted twice weekly a class in German Conversation, for undergraduates and advanced students, and the major course students met each month, during the second half-year, under the direction of Dr. Dippold, for the reading and discussion of essays on works read in the course.

VI. Anglo-Saxon and English.

Advanced courses were conducted by Dr. Wood in:

Anglo-Saxon: Béowulf; Cædmon's Genesis. *Twice weekly.*

Old Saxon: Hêliand. *Weekly. first half-year.*

The advanced students also met fortnightly, under the direction of Dr. Wood, for work in general English philology, reports and discussions. Three of the papers prepared during the year for these meetings, were subsequently read before the University Philological Association.

Additional classes, including the first and second year's courses for undergraduates, were conducted as follows:

Anglo-Saxon: Sweet's Reader; Cynewulf's Elene. *Twice weekly.* DR. WOOD.

Early English (1300-1400). *Twice weekly.* DR. WOOD.

Chaucer. *Weekly.* DR. WOOD.

Shakspeare: Hamlet. *Twice weekly, first half-year.* DR. BROWNE.

English Prose Writers. *Twice weekly, second half-year.* DR. BROWNE.

Elements of English Phonetics. *Weekly, first half-year.* DR. WOOD.

Grammatical and Rhetorical Exercises. *Weekly.* DR. WOOD.

History of the English Language. *Weekly, second half-year.* MR. TOLMAN.

Dr. Browne also conducted twice weekly a general introductory course (P. H. E.) in the History of English Literature, with readings. Essays have been written monthly, by each member of this class, and have been corrected and commented upon by the instructor.

Professor Corson gave twenty public lectures on the Poetry and Drama of the Restoration Period.

Four class lectures on English Literature at the end of the 15th and beginning of the 16th century, were given by Dr. Wood, who also gave eight public lectures on the literature of the period 1500–1580.

Mr. Woodworth met students daily for training in Vocal Culture.

VII. Romance Languages.

Two advanced courses were conducted by Mr. Elliott during the year. For the first of these the work centred in the Anglo-Norman Dialect, for the second in a study of the earliest Old French Monuments. The following special subjects were treated:

Anglo-Norman:—Chardry's *Josaphaz* (XIII century) was taken up and studied in its phonetic relations to earlier works in this dialect, and to the Franco-Norman and the Isle-de-France types. *Weekly, first half-year.*

Old French Seminary:—The Oaths of Strasburg were examined, according to facsimiles of the original MS., in their historical and linguistic relations to the Capitularia Regum and their bearing especially on the earliest development of the Romance system of phonetics. *Weekly, second half year.*

Low Latin:—An Introduction, through the Inscriptions and Joca Monachorum given in P. Meyer's *Recueil d'Anciens textes Bas-Latins, etc. Second half-year.*

Provençal:—The Boethius Hymn, the Girard de Rossillho Epic, with divers extracts, taken according to age, from the literature of the tenth, eleventh, and twelfth centuries. *Weekly, during the year.*

Old French as Introduction to French Philology:—*Aucassin et Nicolete* with special reference to its phonology and dialect character. *Weekly, first half-year.*

Portuguese:—Os Lusiados de Camões was read, attention being given to Old Portuguese, Old Spanish and Latin forms. *Weekly, first half year.*

Wallachian:—An Introduction was given in Cionca's *Practische Grammatik der rumänischen sprache* together with extracts from Sionu, Alexandrescu and Alexandri. *Second half-year.*

Ladinian:—The Musso and Valtelline War Epics (XVI and XVII centuries) were read together with selections from the modern literature of Pallioppi, Caderas, Caratsch, and from the Folk Lore. *Weekly, through the year.*

Lectures:—*(a)* On Spanish and Portuguese Dialects, *weekly, through the year; (b)* On Comparative Romance Grammar, *weekly, through the year; (c)* On French Phonetics, *thirty lectures; (d)* On Dante's Divina Commedia, *seven lectures; (e)* On the History of the Past Participle in French, *two lectures.*

The students of the French Major Course have read with Mr. Todd:

In Classical (XVII century) French, *Le Cid* (Corneille); *Athalie* (Racine), *L'Avare* (Molière); — In Middle (XVI century) French, the most important selections (considerably more than half) of Darmesteter and Hatzfeld's *Morceaux Choisis des Auteurs du* XVI *Siècle*, with a *précis* of Middle French Grammar, *twice weekly, first half-year*;— In Old French, the following selections from Bartsch's *Chrestomathie de l'ancien français: Serments de Strasbourg, Cantilène de Ste. Eulalie, La Passion, St. Léger, St. Alexis, Chanson de Roland, Amis et Amiles, Roman de la Rou, Contes del Graal, Roman de Renart, Roman de la Rose, Conqueste de Constantinople, Chroniques de Froissart, Mémoires de Philippe de Comines, Perceforest, twice weekly, second half-year*;—Composition; exercises in style with the use of Gasc's *Prose Composition*. In the second half-year these were supplemented by original essay writing.

The students of the French Minor Course have read with Mr. Todd:

In Literary French, *Le Roi s'amuse*, by Victor Hugo; *Les Demoiselles de St. Cyr* and *Halifax*, by Alexandre Dumas, *père; Le Gendre de M. Poirier*, by Emile Augier and Jules Sandeau; and a part of *La Chanson du Jardinier*, by André Theuriet, *twice weekly*;—In Historical French, one hundred pages of Voltaire's *Histoire du Siècle de Louis XIV, weekly*;—In Scientific French, eighty pages of Milne-Edwards' *Précis d'Histoire Naturelle, weekly*. In connection with the two latter courses the class has studied nearly all of Breymann's French Grammar; — In Syntax and Idioms the class has had recitations and written exercises on the whole of Part I and twenty-five *thèmes* of Part II of Chardenal's *Exercises for Advanced Pupils, weekly*.

Mr. Fontaine has met the students of the Minor Course five times weekly for French conversation, with systematic instruction and drill in the pronunciation.

Mr. Todd has conducted special courses in Spanish and Italian:

The class in Italian have read the following authors:—Silvio Pellico: *Francesca da Rimini* and sixty chapters of *Le Mie Prigioni*; Goldoni: *Un Curioso Accidente, Gl' Innamorati* and *La Sposa Sagace*; and a short *Storia della Letteratura Italiana*. They have further read short selections from Tommaseo, Mamiani, Manzoni, Botta, Leopardi, Alfieri, Tassoni, Tasso, Ariosto, Petrarch, Boccaccio, and others, *twice weekly*. Short exercises in grammar have been given weekly, in connection with the above readings. A special class in Dante have read Cantos V, XII–XXVI of the Inferno, *weekly*.

The class in Spanish have read the following:—Lope de Vega: *El Desdichado por la Honra*; Calderon: *El Alcalde de Zalamea*; and the whole of Knapp's *Spanish Readings, twice weekly*. Short exercises in grammar have been given weekly, in connection with the above.

Two public courses on French Literature including twenty-three lectures and readings (in French) were given by M. Rabillon. He also conducted classes in French conversation.

The Johns Hopkins Philological Association has met monthly as heretofore. Papers have been read during the session by:

M. Bloomfield.—On certain irregular Vedic subjunctives or imperatives; on a proposed edition of the Kāuçika-sūtra of the Arthava Veda; the probability of the existence of phonetic law.

M. W. Easton.—Uniformity and analogy.

A. E. Egge.—On inchoative or *n*-verbs in Gothic and other Germanic dialects.

A. M. Elliott.—The Nahuatl-Spanish dialect of Nicaragua; the development of verbal parasynthetics in *a* in the Romance Languages.

A. Emerson.—A communication from Prof. E. Wölfflin on the formation of a new Thesaurus Linguæ Latinæ.

B. L. Gildersleeve.—On Ribbeck's life of Ritschl; the Greek final sentence.

J. R. Harris.—On the exemplar of codex C and the apocalypse; notes on the Sinaitic and Vatican codices.

J. A. Harrison.—The syntax of the old past participle and *avoir* in French poetry of the XIIth century.

P. Haupt.—The Babylonian woman's language.

C. W. E. Miller.—Rhythmical pronunciation of Greek and Latin prose and a few remarks on accent.

C. D. Morris.—The rights of a Greek metropolis over its colonies; on K. Brugmann's recent grammatical studies.

E. G. Sihler.—Studies in Dinarchus.

E. H. Spieker.—Note on a certain use of the Sanskrit word *yathā*.

A. S. Tolman.—Musical notation in the study of blank verse.

M. Warren.—Note on Plautus Mercator.

H. Wood.—On T. L. Beddoes, a survival of style.

C. B. Wright.—Parallelisms in Beowulf.

The fourth volume of the American Journal of Philology has been completed during the year and the first number of the fifth volume has been issued.

HISTORY AND POLITICAL SCIENCE.

PROGRAMME FOR 1884-85.

I. Graduate and Advanced Courses.

1. Seminary of American History and Economics.

The Seminary, to which graduate students only are admitted, will be under the direction of Dr. H. B. Adams, assisted by Dr. R. T. Ely and Dr. J. F. Jameson. The regular weekly meetings of the Seminary are held on Friday evenings, each session occupying two hours. At these meetings oral and written reports are made of original investigations that have been carried on by instructors and students working in definite lines.

During the next year there will be three main lines of inquiry, represented by the three instructors in the department of Historical and Political Science and prosecuted with the co-operation of students. The first line is in continuation of the work followed by Dr. Adams and the Seminary for several years and pertains to American institutions of Government, with special reference to certain local, municipal, state, and national types. The second line of original inquiry, under the direction of Dr. Ely, will be the History of Political Economy in the United States, with reference not only to the progress of the science but to the history of taxation and of economic administration in certain representative cities and States. The third line of investigation will be a study of representative State Constitutions, under the guidance of Dr. Jameson, with special attention to the constitutional history of one or two of the States.

The Seminary library of Historical and Political Science is now well supplied with materials for the prosecution of these researches. The collection of local, municipal, state, and national documents is rapidly increasing; and the necessary authorities, historical and economic, sets of journals, etc., are now at the student's command. In addition to the Bluntschli Library, presented to the Uni versity by the German citizens of Baltimore and representing the history, politics, and laws of European States, the institutional and economic history of the United States is represented by a good collection of books.

Other libraries, easy of access, are the Library of Congress, the Peabody Library (numbering eighty thousand volumes, well adapted to certain departments of research), the Library of the Maryland Historical Society (especially rich in *Americana*), the Library of the Baltimore Bar (law reports), and the Maryland Episcopal Library (especially valuable for its original sources of church history).

2. History of Politics.

This course, conducted by Dr. H. B. Adams, will be open to graduate and law students only. It will consist of lectures on the History of contemporary European Politics, beginning with the present century, comparative studies in the History of European Institutions from an earlier date, and practical examinations upon select topics of general Political History. *Three times weekly, through the year.*

The following books are recommended to students proposing to follow this course: Plato's Republic, Aristotle's Politics, Cicero's Republic, Dante's De Monarchia, Machiavelli's Writings, Grotius' Works, Montesquieu's Works, Bluntschli's *Geschichte der neueren Staatswissenschaft* and his *Lehre vom modernen Staat*, with the Works of Francis Lieber. Authorities upon topics for oral examination and special research will be named in connection with the lectures.

3. Finance and Taxation.

A course, adapted to students of law, and conducted by Dr. R. T. Ely. The general principles of Finance, Money, and Banking, and also the special subjects of Taxation in the cities and States of the American Union, together with a sketch of the Financial History of the United States, will be considered. *Three times weekly, through the year.*

4. Comparative Studies in European Administration.

A course of lectures by Dr. Ely on Methods of Administration in England, France, and Germany. Special subjects for consideration will be the organization of governments, their economic functions, sanitary legislation, poor laws, appointment and tenure of officers in the civil service. *Once weekly, through the year.*

5. Lectures on the Early Christian Church.

This course will consist of six lectures by Associate Professor J. Rendel Harris, upon the character, organization, charities, and other institutions of the primitive church.

II. Undergraduate Courses.

1. Physical Geography and History.*

After an entrance examination in Physical Geography and in the History of England and of the United States, the student enters upon the following courses, which, in connection with the study of English, are regarded as fundamental to further undergraduate study.

(*a*) Fifteen class exercises introductory to the study of History, with Dr. H. B. Adams. *Once weekly, first half-year.*

(*b*) Fifteen class exercises upon the relation of Physical Geography to History, with Dr. J. F. Jameson. *Once weekly, second half-year.*

(*c*) History of Greece and Rome (Republic and Empire), with Dr. J. F. Jameson. *Twice weekly, through the year*

—or—

Outlines of European History. Freeman's General Sketch of European History will be used as a text-book, with constant reference to other authorities. *Twice weekly, through the year.*

2. Two Years' Course in History.

FIRST YEAR:

Sources of Greek and Roman History.

The first year's course in History is to be taken with Professor C. D. Morris, Dr. Warren, and Dr. Spieker immediately upon entering the University and consists in the reading of ancient historians,—Herodotus, Thucydides, Livy, and Tacitus,—partly in original texts and partly in translations, with special reference to accuracy in interpretation and to historical style. *Five times weekly, through the year.*

SECOND YEAR:

Mediaeval Church and State.

This will be a course with Dr. H. B. Adams in the study of the relations of the Church to the Roman, Frankish, and German Empires. The course will comprise lectures upon ecclesiastical institutions, reports upon assigned themes, and examinations upon Bryce's "Holy Roman Empire," Lea's "Studies in Church History," portions of Milman's "Latin Christianity," and other authorities. *Twice weekly, first half-year.*

The Italian Renaissance and the German Reformation.

This is a continuation of the preceding course and is devoted to the study of the revival of learning, the history of the Italian Republics and their influence upon Europe, the relation of the German Reformation to Italian Humanism, the progress and results of the Reformation. Essays are to be written by the students in connection with this course and frequent oral examinations are held. *Twice weekly, second half-year.*

History of France and England.

This is a course with Dr. J. F. Jameson in the parallel study of the mediæval and modern history of these two countries. Such textbooks as "The Student's France" and Green's "Short History of England" are used by the class, and other reading is required in connection with assigned topics. *Three times weekly, through the year.*

NOTE.—For the completion of the two years' course in History, individual examinations are required upon an extended course of private reading, especially recommended to each individual; also the preparation of at least five historical essays, satisfactory in point of substance to the instructor in History, and, in point of style, to the instructor in English.

3. Two Years' Course in Political Science.

FIRST YEAR:

Elements of Political Economy.

A preliminary course of instruction with Dr. R. T. Ely comprising lectures, essays, and frequent examinations upon assigned topics. The basis of class-work will be Laveleye's "Elements of Political Economy" and Cossa's "Guide to the Study of Political Economy," with select portions of the writings of John Stuart Mill and other economists. *Five times weekly, first half-year.*

History of Political Economy.

A more advanced course of lectures by Dr. Ely upon the history of various economic systems, including a consideration of some of the contemporary social problems in England and America. *Five times weekly, second half-year.*

SECOND YEAR:

The English and American Constitutions.

A course with Dr. Jameson in the study of the development and present forms of constitutional government in England and the United States. *Three times weekly, through the year.*

The Modern State System.

A course of instruction with Dr. H. B. Adams upon International Relations, Modern Treaties (including those of the United States) and Modern Politics, preparatory to the study of International Law as embodied in Bluntschli's German Code. *Twice weekly, through the year.*

NOTE.—The first year in Political Science is to follow the first year's course in History and is taken in connection with the historical courses on Church and State; Renaissance and Reformation; France and England. In no case can two years' work either in History or Political Science be taken together in one year; but, in cases where only one year can be devoted to these subjects, a half-year in History may be combined with a half-year in Political Science. A year in History may also be combined with a year in Political Science. For the completion of the full undergraduate course in Political Science a prescribed amount of private reading must be offered.

*** Part of what is called the P. H. E. course, required of all undergraduates, and comprising Physical Geography, History, and English.**

WORK OF THE PAST YEAR, 1883-84.

I. Seminary Work.

A. American Institutions and Economics.

The Seminary of Historical and Political Science has met regularly once a week for a session of two hours under the direction of Dr. H. B. Adams. During the past year, attention has been directed especially to the study of American Institutions and American Economics, with reference to specific topics suggested by the instructors in those departments of study.

Among the original papers presented and discussed by members of the Seminary are the following: The Seminary Method, by H. B. Adams; Christian Socialism, by R. T. Ely; Étienne Cabet and his Icarian Community, by Albert Shaw (Doctor's thesis, 1884); Virginia Institutions (three papers), by Edward Ingle; Judicial Procedure among Boys, by John Johnson; State and Local Taxation in Kentucky, by Arthur Yager (Doctor's thesis, 1884); Congressional Government, by Woodrow Wilson.

B. American Colonial History, by Dr. H. B. Adams.

An extra session of the Seminary, one hour a week through the year, has been devoted to the study of the sources of American Colonial History and to the prosecution of certain lines of research suggested by the instructor.

Attention was first called to the history of American discoveries and to early American cartography. The first settlements of Virginia, of New England, and of other colonies were then investigated. Papers were prepared by students upon such subjects as the following: the Spaniards in Florida, the Swedes on the Delaware, the Economic Beginnings of Pennsylvania, the Institutional History of Pennsylvania, the Beginnings of Connecticut, the Institutions of Virginia, Maryland, California and the Southwest, Oregon and the Northwest, etc. Some of this Seminary work will be elaborated into studies suitable for publication. Particular attention was called by the instructor to the development of federal unity among the colonies. The phases of union before the Continental Congress were considered in detail, and some new lines of inquiry were pointed out.

II. Historical and Political Science Association.

In connection with the Seminary, which consists of graduate students devoting their chief attention to History and Economics in this University, is an Association including a few honorary and non-resident members, not directly connected with this institution.

Among those who have addressed the Association during the past year are: Dr. H. Von Holst, on Slavery as an Institution; James Bryce, M. P., on De Tocqueville's Democracy in America; Dr. Charles Gross, on the Guild Merchant, — an Introduction to American Municipal History; Major J. W. Powell, Chief of the Ethnological Bureau, on Indian Institutions; Dr. E. Channing (Harvard), on Town and County Government; Dr. J. Royce (Harvard), on the Development of Society and Government in California.

Among the original papers forwarded to the Association by non-resident members are: Indian Money in New England Civilization, by W. B. Weeden, and Town Government in Rhode Island. by W. E. Foster.

III. Publications.

Some of the principal papers presented to the Seminary or to the Historical and Political Science Association are published in the Johns Hopkins University Studies in Historical and Political Science, a monthly monographic journal, edited by Dr. H. B. Adams. The first volume, devoted to Local Institutions and comprising 470 pages, was completed in October, 1883.

The First Series is devoted, to "American Institutional History," more especially to forms of Local Government. A Second Series, devoted to Local Institutions and American Economics is now in progress. Among the monographs in this volume are Professor Hosmer's, on "Town Meetings"; Professor Macy's, on "The Institutional Beginnings of a Western State (Iowa)"; Dr. L. W. Wilhelm's "Old and New Towns in Maryland"; Dr. R. T. Ely's "Past and Present of Political Economy"; Dr. Henry Carter Adams's "Taxation in the United States, 1789-1816" (Doctor's thesis, J. H. U.) Many of the contributions to the Seminary and Association are published through other channels than the University Studies, *e. g.*, in the Proceedings of Historical Societies, in the Magazine of American History, etc.

IV. Advanced and Collegiate Classes.

Dr. H. B. Adams.

1. Historical Development of International Law.

An advanced course, three hours weekly, first half-year, introductory to the study of Bluntschli's *Völkerrecht* in the German text.

The instructor lectured upon the beginnings of international life as illustrated in ancient and mediæval history. He considered such topics as the inter-tribal and inter-municipal relations of the Orient; the inter-municipal institutions of the Greeks; the international influence of Rome and of the Christian Church; the Italian beginnings of modern international law; and the rise of the state system. In connection with this historical survey of the growth of internationalism, various special papers were presented by members of the class, upon such subjects as Carthaginian treaties, the Roman municipal system, the municipal leagues of the middle ages, etc. In connection with the reading and exposition of Bluntschli's code, a great variety of practical questions pertaining to international politics were discussed by individuals, *e. g.*, France in the Tonquin, the opening of China, the progress of Japan, the control of the Congo, international congresses and tribunals, the Panama Canal, the Monroe doctrine, etc.

2. The Old German Empire and the Rise of Prussia.

This was an advanced course, three hours a week, second half-year, after the conclusion of the course on International Law.

Lectures were given upon mediæval Germany, the origin and development of Prussia, its territorial and dynastic history, its relation to the break-up of mediæval unity and to the re-constitution of Germany. The course was designed to be introductory to the study of European Constitutions and Continental Politics, which subjects will be pursued during the next academic year. In connection with the lectures, oral examinations were instituted upon general topics of European history, which practical exercises will be continued during the coming year.

3. The Beginnings of Church and State.

An undergraduate course, twice a week, first half-year. The course consisted of lectures by the instructor and oral reports by members of the class, in which exercises ten graduate students participated. The instructor considered the origin and spread of Christianity, its relations to the Roman empire and the Germanic peoples; the origin and growth of ecclesiastical institutions, — bishops, presbyters, synods, councils, etc.; the history of the papacy in the middle ages; and the Holy Roman Empire. The students prepared essays and reports upon topics connected with the course and were examined upon the lectures, together with certain prescribed authors,—Bryce, portions of Gibbon, Milman, and Ploetz's Epitome.

4. The Italian Renaissance.

A continuation of the above undergraduate course, two hours a week, second half-year. The course consisted chiefly of lectures upon the history of the Italian republics, the revival of learning and of art, and the relations of Italian to European history. Reading was required in such authors as Burckhardt, Symonds, Grimm, and Hallam; reports were prepared upon assigned topics.

5. Introductory Historical Course.

Twelve lectures to undergraduates entering upon the course in Physical Geography, History, and English.

DR. R. T. ELY.

6. Advanced Course in Political Economy.

This course, three hours weekly, throughout the year, consisted of class-lectures, student-lectures, and occasional special lectures.

The subjects to which particular attention was devoted were as follows: The Historical Development of Economic Theory; the Fundamental Principles of Political Economy, including definitions; Production; Value and Price; Distribution and Consumption; the means of Transportation and Communication; Free Trade and Protection; Social Movements in America. Each student read a paper on some phase of economic history and a number of essays were prepared on the History of Political Economy in the United States. A paper was also read on Taxation in Baltimore, and a careful study of Taxation in Pennsylvania has been begun. An essay on "Icaria, a chapter in the History of American Communism," was prepared and part of it read before the class. This essay by Dr. Albert Shaw is now in press and will be published in book-form by Messrs. G. P. Putnam's Sons.

7. Minor Course in Political Economy.

The first part of this course consisted of lectures on the Elements of Political Economy and a careful study of John Stuart Mill's Principles of Political Economy, with frequent reference to Walker's "Political Economy," and other works. The second part consisted of lectures on Historical Systems of Political Economy. At least two papers were prepared and read by each member of the class. A few of the subjects treated were as follows: The Wage-Fund Theory; Trades Unions and Strikes; The Internal Revenue of the United States; the Income Tax; Communistic Experiments in the United States; The Independent Treasury System of the United States; the Theory of Value.

DR. J. F. JAMESON.

8. History of England and France.

This course, three hours weekly throughout the year, formed, with Dr. Adams's undergraduate work, the minor course in History. Green's England and Masson's Guizot's France were used as text-books. The recitations were accompanied by informal lectures. Reports upon topics, specially assigned, and studied under the direction of the instructor, were made. Additional reading in the standard authors was required. Formal lectures brought the course down to the present time.

9. History of Greece and Rome.

Twice weekly throughout the year. Text-books were used, informal and occasionally formal lectures were given, and selected topics were reported upon.

10. English Constitutional History.

Once a week. Stubbs' "Select Charters and other Documents illustrative of English Constitutional History" was used; the period studied was that from 1066 to 1216, special attention being paid to the development of the principles established by Magna Charta.

11. Physical Geography.

Lectures on the relations of Physical Geography to History (with special reference to Greece and Italy) were given once a week, beginning in January.

Courses of public lectures were also given in Hopkins Hall:—on the Relation of History and Politics, by Professor H. VON HOLST, of the University of Freiburg, and on the Study of Roman Legal History, by Professor JAMES BRYCE, of the University of Oxford.

PHILOSOPHICAL COURSES.

PROGRAMME FOR 1884-85.

A. For Advanced and Special Students.

PSYCHOLOGY AND PEDAGOGICS.

PROFESSOR G. STANLEY HALL will direct the studies of all advanced students who wish to take up the study of Psychology or Pedagogy upon the following plan.

1. He will lecture twice a week in the Biological Laboratory on Psycho-Physiology. Though in the main, a continuation of the course begun in February, 1884, these lectures will be open to other graduate students who have heard Professor Martin's course in animal physiology or done work elsewhere which can be accepted as its equivalent.

Beginning with compound reflex-action and instinct in animals, such topics as memory, association of ideas, attention, volition and feeling in their morbid and normal forms will be discussed as far as possible on a physiological basis. The contributions of psycho- and neuro-pathology to the understanding of the normal function and histology of the cerebro-spinal nervous system will receive special attention. In connexion with this part of the course demonstrative and observational exercises in human neurology will be offered to those who desire them. The psychology and pathology of speech and writing will be illustrated. The psychological parts of anthropology, the evolution of the psychic faculties in children and in the race, etc., will be summarized and will introduce the psychology of national and other comprehensive systems of opinion and thought. In short, the endeavor will be to give as briefly as possible a general survey of the vast field of modern scientific psychology, with such details, demonstrations and illustrations as the time will permit.

This course is intended:

For those who desire to carry on the study of biology by experimental methods into the study of the psychic functions of animals and man:

For those intending to give attention to the study of psychiatric medicine:

For those interested in medical jurisprudence or in linguistic psychophysics:

For special students of philosophy.

2. He will encourage and direct Psycho-Physic research with carefully selected original themes approved by him, with a view apart from results, to the educational significance of these methods as a field of applied logic.

3. He will lecture once weekly on the History of Modern Philosophical and Educational Ideas, beginning with the scholastic period.

The views of representative modern philosophers will be sketched; and, as the basis of educational ideas necessitates a broader survey, selected chapters from the history of science, medicine, and belief will be added. In tracing the application of these to education in the broader and higher sense, such topics will be discussed as *e. g.*, the organization and operation of learned societies and scientific and other academies; the constitution and methods and history of European universities from the Renaissance; the educational value of philosophical systems; professional schools of law, medicine, theology, technological and industrial schools; the French, English, German, and American school and college system in their method and idea; the development and nature of student life; history and theory of examinations and degrees and academic festivals and traditions; special methods and problems of pedagogics at the present time.

These lectures are especially designed to serve:

Those graduate students desiring to become teachers or professors:

Students of history, and more particularly of philosophical and educational opinion and method or those intending to plead or preach:

Those intending to teach philosophy.

4. He will hold a weekly conference during a part of the year at which others whose names are to be announced later will assist.

5. In connection with the work of the above courses, rooms, apparatus, and books are to be provided, and bibliographies of a special and descriptive kind will be printed as guides to reading and reference.

HISTORY OF PHILOSOPHY AND ETHICS.

Professor G. S. Morris will give the following courses:

1. Lectures on the History of Philosophy in Greece.

Twice weekly, first half-year.

Topics involved:—

The beginnings of science. Anticipations of the modern doctrine of development. Establishment of elementary conceptions of physical science. First application of mathematical conceptions to the comprehension of the universe. Beginnings of abstract speculation. First successful development of concrete or substantial idealism, including science of method (logic), and philosophy of nature, man, the State, art, and education. Systems of practical philosophy.

2. Ethics, or the Science of Man.

Two lectures weekly, first half-year.

A consideration of the foundations and content of ethical science, together with an historical survey.

Topics involved:—

The different forms of science. Relation of ethics to anthropology, physiology, and psychology. The distinction and the concrete unity of body, soul, and spirit. Ethics proper, the science of man as practical intelligence. Man prefigured in nature. Self-consciousness. Its relation to animal instinct. Its realization in the moral organisms of family, State, and religion. Conscience. Will. The good of man: Happiness or pleasure? Character. The system of virtues and duties. The types of ethical opinion, as illustrated in the ancient and modern history of philosophy.

3. Professor Morris will further be prepared, according as the demands or needs of students may require, to lecture on the lessons of Modern Philosophy, the philosophy of the State (with special reference to Aristotle, Hobbes, Hegel, and Spencer), or "Real Logic" ("Metaphysics,"—with special reference to Aristotle, Leibnitz, and later German Philosophers).

Books of Reference.

Course I:—1. Mullach, *Fragmenta Philosophorum Graecorum*;—2. Ritter et Preller, *Historia Philosophiæ Graeco-Romanæ ex fontium locis contexta*;—3. The works of Plato and Aristotle;—4. E. Zeller, *Geschichte der griechischen Philosophie*, (*German and English translation*);—5. Ueberweg, *History of Philosophy, Vol. I*;—6. Noack, *Philosophie-geschichtliches Lexikon*;—7. Numerous monographs on special topics (to be found in the Library of the University and in the Peabody Library)

Course II:—1. I. H. Fichte, *System der Ethik*, 1 Band: *Geschichte der Ethik*;—2. H. Sidgwick, Historical Article on "Ethics," Encyclopaedia Britannica, 9th edition;—3. Aristotle, *Nicomachean Ethics*;—4. Martensen, *Christian Ethics*;—5. Spinoza, *Ethica*;—6. Bishop Butler, *Sermons*;—7. Kant, *Ethical Works*;—8. Fichte, *Works*;—9. Hegel, *Philosophie des Geistes*;—10. J. S. Mill, *Utilitarianism*;—11. H. Spencer, *Data of Ethics*;—12. H. Sidgwick, *Methods of Ethics*;—13. F. H. Bradley, *Ethical Studies*;—14. T. H. Green, *Prolegomena to Ethics.*

B. Course Required of all Matriculated Students.

This course will comprise five hours per week throughout the year, and includes Logic, Ethics, and Psychology (hence known as the L. E. P. Course). A special instructor will be appointed to assist under Dr. Hall's direction in this work, which will consist of lectures, recitations, themes, epitomes, etc. These subjects will be taken up in the following order.

1. Inductive and Deductive Logic.

Text-books: Fowler, with references to Jevons, Mill, Venn, Sigwart, and Wundt.

2. General Psychology.

Text-books: Sully's Psychology in selections, with references to Porter, Ryland, Carpenter.

3. Positive and Practical Ethics.

This part of the course will be taught in part by lectures and will comprise such topics as mental and physical regimen and hygiene, methods and general ends of study, the needs and sanctions of positive personal convictions and purposes in the conduct of the understanding and of life, mental self-knowledge as opposed to self-consciousness, and the utilization of individual experience in self-education, social ethics, need of religious sentiments for the maturity and sanity of conscience, etc.

Books of reference: Maurice's *Social Morality*, Grote's *Treatise on the Moral Ideals*, Wuttke's *History of Christian Ethics*, Wayland's *Moral Philosophy*, Calderwood's *Moral Science.*

4. In addition to the above required courses, a series of lectures will be given by Dr. Hall, during the latter part of the year intended at once to conclude matriculate and introduce advanced study of philosophy.

WORK OF THE PAST YEAR, 1883-84.

Philosophy.

Professor G. Stanley Hall lectured twice a week through the second half-year on Psycho-physics.

The course was mainly devoted to the physiology of the senses, cerebro-spinal localization and attention, as introductory to a course on psychology, beginning with instinct, during the coming year. Demonstration work was done and courses of reading posted.

Six advanced students engaged in special investigations in the room set apart for psycho-physic research and results were obtained that will be published later.

Dr. Hall lectured twice a week on psychological ethics, mainly historical, beginning with ethical conceptions and theories of the Greeks and concluding with Kant, and considerable attention was given to inductive methods of studying ethical problems.

He also gave twelve lectures to the matriculate students on Mental Hygiene.

Professor G. S. Morris gave during the first half-year:

1. A course of three lectures weekly on the History of Philosophy in Germany, with special reference to the movement from Kant to Hegel.

The beginnings and the general character of the history of modern philosophy were first briefly sketched; the doctrines of Descartes, Spinoza, and Leibnitz were described in greater detail; and then, after a summary account of the philosophical situation in Germany prior to Kant, the doctrines of Kant were analyzed, with special reference to the unity of the three *Critiques*, and to the comprehension of the fundamental problems of philosophy, as anew presented by Kant, (1) in the light of the results of ancient philosophy, and (2) with reference to the further treatment of these problems by the successors of Kant. This course was designed for advanced students.

2. A Seminary course, for the most advanced students only, was conducted, the subject of study being Spinoza's *Ethics*. The work in this course was restricted especially to the first, second, and fifth parts of Spinoza's masterpiece.

The object of the study was to attain an exact knowledge of the nature of Spinoza's fundamental conceptions and of his method, to estimate their value and significance in the light of the larger historic results of philosophic inquiry, and, in some measure, to consider their relation to the fundamental conceptions of modern science. In accordance with the Seminary method, the different members of the class by turns took the lead in the analytic exposition of the text and criticism of the argument.

3. An outline of the general History of Philosophy, both ancient and modern, was given in a series of two lectures weekly, throughout the first half-year.

This was intended for undergraduates and others desiring to take advantage of such a course. Members of the L. E. P. course were required to listen to and be examined on twelve lectures relating to modern philosophers.

4. A course of four public lectures on the Philosophy of Social Relations, was also given by Professor Morris.

MR. C. S. PEIRCE gave a course of lectures in Mathematical Logic, twice weekly through the year; a course in Philosophical Terminology, weekly during the first half-year; and a course in Probabilities, twice weekly during the second half-year.

He also guided a company of students in studying the psychology of great men.

MR. HARRIS gave an elementary course in Logic during the first half-year and a course in Practical Ethics during the second half-year.

Two public lectures on the Religious Aspect of Philosophy were given by Dr. Josiah Royce, of Harvard College.

A course of lectures upon educational topics was given on Saturday mornings to a company of about eighty graduate students who were preparing themselves for the work of teachers in colleges and high schools. Lectures were given by President Gilman, Professors Gildersleeve, Remsen, Martin, Hall, Doctors Adams and Wood, and Mr. Peirce.

CONFERRING OF DEGREES.

JUNE 5, 1884.

The Commencement exercises of the Johns Hopkins University took place on Thursday, June 5, 1884. The ceremonies were attended by a large company, consisting of the trustees and instructors of the University, and the friends of the graduates.

An address to the graduates was made by President Gilman. In this he considered the attitude which the young men should take in respect to Education, Politics, and Religion.

Professor C. D. Morris, on behalf of the Board of Collegiate Advisers, presented the candidates for the degree of Bachelor of Arts, and that degree was conferred on the persons named in the following list.

The candidates for the degree of Doctor of Philosophy were presented by the heads of the respective departments of study on behalf of the Board of University Studies, and the degree was conferred on the persons named in the following list.

After the close of the exercises in Hopkins Hall, there was a social assembly of the graduates and their friends in the new Gymnasium.

Doctors of Philosophy.

HERBERT WILLIAM CONN, of Fitchburg, Massachusetts, A. B., Boston University, 1881. His principal subject has been Animal Morphology, the subsidiary, Animal Physiology and Histology. His thesis on the "Life-History of Thalassema Millita" has received one of the Walker prizes of the Boston Society of Natural History.

ELLERY WILLIAM DAVIS, of Oconomowoc, Wisconsin, S. B., University of Wisconsin, 1879. His principal subject has been Mathematics, the subordinate, Physics. He submitted a thesis on the "Parametric Representation of Curves."

DAVID TALBOTT DAY, of Baltimore, A. B., Johns Hopkins University, 1881. His principal subject has been Chemistry, the subordinate, Physics. He submitted a thesis on the "Changes effected by Heat in the constitution of Ethylene."

JOHN DEWEY, of Burlington, Vermont, A. B., University of Vermont, 1879. His principal study has been Philosophy, the subsidiary, Political Science. He submitted a thesis on the Psychology of Kant.

JAMES REYNOLDS DUGGAN, of Macon, Georgia, A. B., Mercer University, 1877, and M. D., Jefferson Medical College, 1879. His principal subject has been Chemistry, the subordinate, Biology. He submitted a thesis on "Fermentation."

WILLIAM HENRY HOWELL, of Baltimore, A. B., Johns Hopkins University, 1881. His principal subject has been Animal Physiology and Histology, the subordinate, Chemistry. He submitted a thesis entitled "Experiments upon the Blood and Lymph of the Terrapin, and the origin of the Fibrin formed in Coagulation.

HANS CARL GÜNTHER VON JAGEMANN, of Naumburg, Germany, a graduate of the Naumburg Gymnasium. His principal subject has been the Romance Languages, the subordinate, English and German. He submitted a thesis on the "Anglo-Norman Vowel System in its relations to the Norman words in English."

EDWARD HARRISON KEISER, of Allentown, Pa., B. S., Swarthmore College, 1880. His principal study has been Chemistry, the subordinate, Physics. His thesis was on "The Existence of Active Oxygen."

ARTHUR LALANNE KIMBALL, of Plainfield, N. J., A B., Princeton College, 1881. His principal subject has been Physics, the subsidiary, Mathematics. He submitted a thesis on the "Value of the B. A. Unit of Electrical Resistance in Absolute Measure."

HENRY LESLIE OSBORN, of Madison, N. J., A. B., Wesleyan University, 1878 His principal subject has been Animal Morphology, the subsidiary, Animal Physiology and Histology. His thesis on "The Gill in some forms of Prosobranchiate Mollusca" has already been printed in the Studies from the Biological Laboratory.

Charles Albert Perkins, of Ware, Mass., A. B., Williams College, 1879. His principal subject has been Physics, the subordinate, Chemistry. He submitted a thesis on the "Variation of the Magnetic Permeability of Nickel at different temperatures."

Albert Shaw, of Grinnell, Iowa, A. B., Iowa College, 1879. His principal study has been History, the subordinate, Political Science. His thesis entitled "Étienne Cabet and the Icarian Community," is to be published in book-form by G. P. Putnam's Sons, New York.

Henry Newlin Stokes, of Moorestown, N. J., S. B., Haverford College, 1878. His principal subject has been Chemistry, the subsidiary, Animal Physiology and Histology. His thesis was on "The nature of the Sulphinide obtained by oxidizing a-Naphthalene-sulphamide.

Lewis Webb Wilhelm, of Baltimore, A. B., Johns Hopkins University, 1880. His principal subject has been History, the subordinate, Political Science. His thesis, entitled "Sir George Calvert, Baron of Baltimore," has been read before the Maryland Historical Society, and accepted for publication.

Arthur Yager, of Georgetown, Ky., A. B., Georgetown College, 1879. His principal subject has been History, the subsidiary, Political Science. He submitted a thesis on "State and Local Taxation in Kentucky."

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Bachelors of Arts.

Albert Clayton Applegarth, of Baltimore, a former student of the City College.
Principal Studies: Chemistry and History;—German, Mathematics, and Political Economy.

Charles Walter Artz, of Hagerstown, Maryland, who pursued his preliminary studies under Mr. J. T. Carlile.
Principal Studies: German and Political Science;—Physics, History, French, and English.

Walter Bliss Canfield, of Baltimore, who pursued preparatory studies under Mr. G. G. Carey.
Principal Studies: History and Political Economy, and Latin; —French, Greek, and Chemistry.

George Gibson Carey, Jr., of Baltimore, who pursued his preliminary studies with Mr. G. G. Carey.
Principal Studies: History and Political Economy, and Latin; —Physics, German, and French.

William Kennedy Cromwell, of Baltimore County, who pursued preparatory studies with Mr. H. W. Luckett.
Principal Studies: History and Political Economy, and German;—Chemistry, Latin, and French.

Charles William Rammelsberg Crum, of Jefferson, Maryland, a former student of Franklin and Marshall College.
Principal Studies: Mathematics and Physics;—English, French, and German.

Harry Friedenwald, of Baltimore, a former student of the City College.
Principal Studies: Biology and Chemistry;—French, Philosophy, and Physics, with English and History.

William Lindsay Glenn, of Baltimore, who pursued his preliminary studies under Mr. G. G. Carey.
Principal Studies: Latin and Greek;—French and Physics, with English, Ethics, and History.

John Hinkley, of Baltimore, who pursued preparatory studies with Mr. G. G. Carey.
Principal Studies: History and Political Economy, and Latin; —German, French, Chemistry, and Physics.

Charles Howard Howard, of Baltimore, who pursued his preliminary studies with Mr. W. S. Marston.
Principal Studies: History and Political Science, and Greek;— Physics, Latin, and Logic, with English and Ethics.

John Deering Lord, Jr., of Baltimore, who pursued preparatory studies with Mr. M. A. Newell.
Principal Studies: History and Political Economy, and Latin; —Physics, French, and German.

Jere Williams Lord, of Baltimore, who pursued preparatory studies under Mr. M. A. Newell.
Principal Studies: Biology and Chemistry;—Physics, English, and French, with Logic, Ethics, and Psychology.

William Patrick Lyons, of Baltimore, a former student of Loyola College.
Principal Studies: French and History;—Latin, Philosophy, Physics, and German.

Edgar George Miller, Jr., of Baltimore, who pursued his preliminary studies under Mr. L. V. Tuttle.
Principal Studies: History and Political Economy, and German;—Latin, Greek, Physics, and Chemistry.

William Ridgely Orndorff, of Baltimore, a graduate of the City College in 1881.
Principal Studies: Chemistry and German;—French and Physics, Logic and Psychology, English and History.

George Dobbin Penniman, of Howard County, a former student of the City College.
Principal Studies: History, Philosophy, and German;—French, Latin, and Physics.

William H. Perkins, of Baltimore, who pursued preparatory studies with Mr. W. S. Marston.
Principal Studies: Mathematics and French;—Latin, German, and Physics.

George Clement Stokes, Jr., of Govanstown, Maryland, who pursued his preliminary studies with Dr. J. C. M. Mérillat.
Principal Studies: History and Political Science, and German; —Physics and Latin, Logic, Ethics, and Psychology.

William Jones Thomas, of Baltimore, a former student of Randolph Macon College.
Principal Studies: Mathematics and History;—German, Latin, and Physics.

William Ferdinand Walz, of Baltimore, a graduate of the City College in 1881.
Principal Studies: Greek and Latin;—French, Chemistry, and History.

Frederick Henry Wilkens, of Baltimore, who pursued his preliminary studies under Mr. E. M. Lamb.
Principal Studies: Greek and Latin;—German, English, and Chemistry, with History and Ethics.

George Wishart Edmond, of Portland, Maine, a former student of Amherst College.*

Charles Howard Shinn, of San Francisco, California, a former student of the University of California.*

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*On these two gentlemen, who had pursued studies here, the Board of Collegiate Advisers recommended that the degree should be conferred *extra ordinem*, since the Board had satisfactory evidence of their good attainments in many branches of a liberal education.

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CALENDAR, 1884–85.

Tuesday, September 23.	**Academic Year Begins.**
Tuesday, September 23.	**Examinations for Matriculation Begin.**
Tuesday, September 30.	**Instructions Resumed.**
Friday, June 12.	**Academic Year Closes.**

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NOTES AND COMMUNICATIONS.

MATHEMATICS.

Equations in Matrices. By J. J. Sylvester.

[Extract of a letter from Professor Sylvester to Dr. F. Franklin].

I have been lately considering the subject of equations in matrices. Sir William Hamilton in his "Lectures on Quaternions" has treated the case of what I call unilateral equations of the form $x^2 + px + q = 0$, or $x^2 + xp + q = 0$, where we may, if we please, regard x, p, q as general matrices of the second order. He has found there are six solutions, which may be obtained by the solution of an ordinary cubic equation. In a paper now in print and which will probably appear in the May number of the *Philosophical Magazine*, I have discussed by my own methods the general *unilateral* equation, say

$$x^\omega + px^{\omega-1} + qx^{\omega-2} + \ldots + l = 0,$$

where $x, p, q \ldots l$, are quaternions or matrices of the second order, and have shown, by a method satisfactory if not absolutely rigorous, that the number of solutions is $\omega^3 - \omega^2 + \omega$, that is to say, the nearest superior integer to the general maximum number of roots (ω^4) divided by the augmented degree $(\omega + 1)$.

But after I had done this it occurred to me that there were multitudinous failing cases of which neither Hamilton nor myself had taken account, as *ex. gr.* $x^2 + px = 0$, besides the solutions $x = 0$, $x = -p$, will admit of a solution containing an arbitrary constant, I think; but that is a matter which I shall have to look further into before committing myself to a positive assertion about it. I have only had time to pass in review the more elementary case of a unilateral simple equation, say $px = q$, where p, q are matrices of any order ω.

If p is non-vacuous there is one solution, viz.; $x = p^{-1}q$; but suppose p is vacuous: what is the condition that the equation may be soluble?

1°. Suppose $q = 0$, p being vacuous has for its identical equation $pP = 0$, and consequently we may make $x = \lambda P$ where λ is an arbitrary constant.

2°. Suppose q is finite and that $x = r$ is one solution, then obviously the general solution is $x = r + \lambda P$.

We have now to inquire what is the condition that r may exist. I find from the mere fact of x being indeterminate (and confirm the result by another order of considerations) that the determinant of $q + \lambda p$ must vanish identically; so that for instance when p, q are of the second order and $\begin{matrix} & b' & c \\ d & e & f \end{matrix}$ are the *parameters to the corpus* (p, q), we must have when $d = 0$, which is implied in the vacuity of p, $f = 0$ and $e = 0$. The first of these conditions is known *à priori* immediately from my third law of motion; but not so, without introducing a slight intervening step, the intermediate one (I mean the connective to d and f, viz.) $e = 0$.

So in general in order that $px + q = 0$ may be soluble, *i. e.* in order that $p^{-1}q$ where p is simply vacuous may be *Actual* and not Ideal, q must satisfy as many conditions as there are units in the order of p or q, all implied in the fact that the determinant to $p + \lambda q$, where λ is an arbitrary constant, vanishes identically. When these conditions are satisfied $p^{-1}q$ becomes actual but indeterminate. (This, by the way, shows the disadvantage of calling a *vacuous* matrix *indeterminate*, as was done in the infancy of the theory by Cayley and Clifford—for we want this word as you see to signify a combination of the inverse of a vacuous matrix with another which takes the combination out of the ideal sphere and makes it actual).

So in general in order that $p^{-1}q$ where p is a null of the ith order (*i. e.* where all the $(i + 1)$th but not all the ith minors of p are zero) shall be an actual (although indeterminate) matrix, it is necessary and sufficient that $p + \lambda q$, where λ is arbitrary, shall be a null of the same (ith) order. What will be the degree of indeterminateness in $p^{-1}q$, *i. e.* how many arbitrary constants are contained in the value of x which satisfies the equation $px = 0$ remains to be considered.

The law as to the conditions is an immediate *corollary* to my third law of motion, for if $px = q$ then $p + \lambda q = p\ (1 + \lambda x)$; consequently $p + \lambda q$, whatever λ may be, must have at least as high a degree of nullity as p. Q. E. D.

Oxford, April 12, 1884.

Note on Peirce's Linear Associative Algebra. By A. Cayley.

I find that to the double systems given by Peirce, viz.,

$$(a_2)\ \begin{array}{c|c|c|} & x & y \\ \hline x & x & y \\ \hline y & y & 0 \\ \hline \end{array} \qquad (b_2)\ \begin{array}{c|c|c|} & x & y \\ \hline x & x & y \\ \hline y & 0 & 0 \\ \hline \end{array} \qquad (c_2)\ \begin{array}{c|c|c|} & x & y \\ \hline x & y & 0 \\ \hline y & 0 & 0 \\ \hline \end{array}$$

should be joined

$$(d_2)\ \begin{array}{c|c|c|} & x & y \\ \hline x & x & 0 \\ \hline y & y & 0 \\ \hline \end{array}\ .$$

To show that this is really distinct from (b_2), observe that starting from (b_2) and writing $z = ax + \beta y$, we have $z^2 = a^2x^2 + a\beta(xy + yx) + \beta^2y^2 = a^2x + a\beta y, = a(ax + \beta y)$: whence in (b_2), $z = x + \beta y$, β arbitrary, is the only idempotent symbol, and y is the only nilpotent symbol. And z having this value $= x + \beta y$, we have $z^2 = z$, $zy = y$, $yz = 0$, $y^2 = 0$; viz., in (b_2) introducing the general symbol z in place of x, the system in z, y retains its original form; that is, we cannot in anywise transform (b_2) into (d_2). I have further considered the question in a paper communicated to the London Mathematical Society but not yet published.

Cambridge, England, May 12, 1884.

On the Equations which determine the Axes of a Quadric Surface. By W. E. Story.

[Abstract of a communication to the University Mathematical Society, May 21, 1884].

If $u_1, u_2, u_3, \ldots, u_n$ are homogeneous point (or tangential) coordinates in an $(n - 1)$-fold space, and

$$Q_{uu} \equiv \textstyle\sum_i\sum_k b_{ik}u_iu_k = 0 \qquad (b_{ik} = b_{ki})$$

is the equation of the absolute, where the summation extends to all integral values of i and k from 1 to n, inclusive; the coordinates of the centres (or principal sections) of the quadric surface whose equation is

$$P_{uu} \equiv \textstyle\sum_i\sum_k a_{ik}u_iu_k = 0 \qquad (a_{ik} = a_{ki})$$

are determined by the equations

$$(1) \qquad \textstyle\sum_i a_{ik}u_i = \lambda\sum_i b_{ik}u_i,$$

being n equations corresponding to the values $k = 1, 2, 3, \ldots, n$ respectively, in which λ is a parameter whose value is determined by the condition that equations (1) shall be coexistent for some set of values of the u's, *i. e.* by the vanishing of the determinant of the n-th order whose constituents are $a_{ik} - \lambda b_{ik}$. Let

$$P_{vw} \equiv \textstyle\sum_i\sum_k a_{ik}v_iw_k, \qquad Q_{vw} \equiv \sum_i\sum_k b_{ik}v_iw_k,$$

then $Q_{vw} = 0$ is the condition that the two points (or planes) v and w shall be mutually perpendicular and $Q_{v\sigma}Q_{w\tau} - Q_{v\tau}Q_{w\sigma} = 0$ is the condition that the lines joining the points vw and $\sigma\tau$ respectively (or the intersections of the planes vw and $\sigma\tau$ respectively) shall be mutually perpendicular. Now let $\mu, v_1, v_2, \ldots, v_n$ and $\nu, w_1, w_2, \ldots, w_n$ be any two different sets of solutions of equations (1), so that μ and ν are different, then

$$(2) \qquad \textstyle\sum_i a_{ik}v_i = \mu\sum_i b_{ik}v_i, \qquad \sum_i a_{ik}w_i = \nu\sum_i b_{ik}w_i;$$

operating on the first set of these equations with $\sum_k w_k$ and on the second set with $\sum_k v_k$ we obtain, on account of the symmetry of P_{vw} and Q_{vw},

$$(3) \qquad P_{vw} = \mu Q_{vw}, \qquad P_{vw} = \nu Q_{vw},$$

and hence, since μ and ν are different,

$$(4) \qquad P_{vw} = 0, \qquad Q_{vw} = 0,$$

i. e. any two different centres (or principal sections) of a quadric are mutually perpendicular. The axes of a quadric are the lines joining the centres (or intersections of the principal sections), and if v, w, σ, τ are centres (or principal sections) of which at least three are different, we have, by (4),

$$Q_{v\sigma}Q_{w\tau} - Q_{v\tau}Q_{w\sigma} = 0,$$

i. e. any two axes of a quadric are mutually perpendicular.

Some Remarks on Unicursal Curves. By E. W. Davis.

[Read at a meeting of the University Mathematical Society, March 19, 1884].

If from the equation of any unicursal curve

$$x_1 : x_2 : x_3 = f_1(\lambda, 1) : f_2(\lambda, 1) : f_3(\lambda, 1),$$

we attempt to find an expression for λ we shall find that it takes the form

$$\lambda = \frac{\phi_1(x_1 x_2 x_3)}{\varphi_2(x_1 x_2 x_3)},$$

where the ϕ's are rational homogeneous functions.

If the order of the unicursal curve u is n and that of the highest of the ϕ's m, then the curve $\varphi_1 - \lambda\varphi_2$, or ϕ intersects u in mn points; but as each value of λ determines but one point on u it must be that $mn - 1$ of these points are the same for all values of u and are among the intersections of ϕ_1 and φ_2.

If u has double points these must be among the fixed points and the two intersections at the double point will only count for one in the determination of φ.

We may say that one intersection has been absorbed by the double point. A triple point would absorb two intersections, an r-fold point $r - 1$ intersections, but we shall assume that in general a unicursal has no multiple points of higher order than the second, an assumption which we shall see to be perfectly justifiable. If then a curve is unicursal it is always possible to pass curves through all its double points and have the curves determined, but no more than determined by their intersections with the unicursal curve.

Suppose u has $\frac{n-1\,.\,n-2}{2} - D$ double points, then we have

$$(1) \qquad nm - \frac{n-1\,.\,n-2}{2} + D = \frac{m\,.\,m+3}{2},$$

which says that the intersections of u and ϕ, less the number of intersections absorbed by the double points of u, is equal to the number of points needed to determine φ.

But further, ϕ must be of an order sufficiently high to pass through all these double points and yet not be completely determined, *i. e.*,

$$(2) \qquad \frac{n-1\,.\,n-2}{2} - D < \frac{m\,.\,m+3}{2}.$$

If we solve (1) for m we find

$$m = \frac{2n-3}{2} \pm \tfrac{1}{2}\sqrt{1+8D},$$

which shows that D cannot be negative and must be of the form $\frac{k\,.\,k+1}{2}$. This gives $m = n - 1 + k$ and $n - 2 - k$.

For the first value of m, k must be zero unless $n = 1$ or 2, since if a curve of the mth order intersect one of the nth order ($m \overline{\gtrless} n$) in $mn - \frac{n-1\,.\,n-2}{2}$ points, the remaining $\frac{n-1\,.\,n-2}{2}$ points of intersection are completely determined. And for the second value of m, k must also be zero, as the addition of (1) and (2) shows that $m > n - 3$.

If u break up it must do so in such a way as not to increase the number of double points. It cannot therefore break up all into curves of zero deficiency, (conics and right lines). All the curves into which it breaks up will be of order $\overline{\gtrless}\, m$, except in the one case where $m = n - 2$, and u breaks up into a curve of order $(n - 1)$ and a right line which would necessitate ϕ meeting the line in $n - 1 = m + 1$ points. Any such curve of order k being met by ϕ in $mk - \frac{k-1\,.\,k-2}{2}$ points will have all of its intersections with ϕ completely determined.

For instance, suppose that a curve of the 5th order breaks up into a conic and a cubic. A second cubic passing through the six intersections of the conic and cubic will meet the first cubic in three remaining points, any two of which determine the third; or a quartic passing through the six intersections of conic and cubic will meet the cubic in six additional points of which only five can be taken at random.

If u has multiple points of a higher order than the second, we can use the same construction if through each r-fold point of u we pass ϕ $r - 1$ times. For in so doing it intersects ϕ $r\,.\,r - 1$ times as it would in passing through $\frac{r\,.\,r-1}{2}$ double points on u, and upon ϕ are imposed

$$\frac{r-1\,.\,r-2}{2} + r - 1 = \frac{r\,.\,r-1}{2}$$

conditions, the same as would be imposed by passing through $\frac{r\,.\,r-1}{2}$ double points on u.

Other constructions are allowable however. Thus, if u has an $(n - 1)$-fold point we may take for ϕ a line through the $(n - 1)$-fold point and meeting the curve besides in one variable point. Again if u is of order $2n$ and has 3 n-fold points and one $(n - 1)$-fold point or is of order $2n + 1$ and has 3 n-fold points and one $(n + 1)$-fold point, it will have zero deficiency, and we may take for ϕ a conic passing through these four multiple points and meeting u in yet one other point.

Again, we may if there are multiple points of higher order than the second always take for ϕ a curve of order $n - 3$ passing through one of these multiple points of order r, $r - 2$ times and through the rest $r - 1$ times. The simplest case of this is when we have a triple point and $\frac{n-1\,.\,n-2}{2} - 3$ double points.

An examination of curves to the 12th order inclusive showed these to be the only ways in which we could take ϕ for those curves and rendered it exceedingly probable that no other solution was possible for any plane curves whatsoever. The general proof would require us to show that.

Given $2 < m < n - 3$,

$$\sum(r\,.\,r-1) = n-1\,.\,n-2,$$
$$\sum(r-1) = nm - \frac{m\,.\,m+3}{2},$$

that then the number of r's $> \frac{m\,.\,m+3}{2} - 1$,

$$\text{or } \sum r > mn - 1.$$

It was noticed that when we came to curves of the 10th order certain arrangements of multiple points appeared which were plainly impossible, *e. g.*, a 7-fold and a 6-fold point would be equivalent to 36 double points, the number possible on the curve of 10th order, but a line through them would meet the curve in thirteen points.

Note on the foregoing paper. By G. Bissing.

It may be interesting to note that the theorem for n-fold space, analogous to that made the subject of Mr. Davis's communication, is "a unicursal curve of degree p in n-flat space has $\frac{1}{2}(p-1)(p-2)\,\overline{n-2}$ flats passing through $n - 2$ fixed points on or off the curve and two variable points on it." In four-fold space for instance take all the planes through any two fixed points and two variable points on the curve, and take for one of the fixed points the point at infinity on the fourth co-ordinate axis. Then from this point at infinity project the curve, planes, &c., into three-fold space. The curve becomes a curve, the remaining fixed point a fixed point (the one from which we project being lost), and the planes become the lines through one fixed point and two variable points on the curve in which they actually cut the three-fold space. That is, every one of the singularities in question is projected into an apparent double point, and the converse is also true. It is furthermore evident that this same reasoning will hold in general. Since therefore a unicursal curve of degree p in three-fold space has $\frac{1}{2}(p-1)(p-2)$ apparent double points, the proposition is proved.

Note on Cycles. By A. S. Hathaway.

[Read before the University Mathematical Society at a meeting held March 19, 1884].

A cycle may be defined as an assemblage of terms such that if all the terms are multiplied by any given one, the assemblage remains unaltered, the terms being simply interchanged. Examples of cycles are: the four fourth roots of unity, $1, -1, \sqrt{-1}, -\sqrt{-1}$; the two sets of residues of 15, 1, 2, 4, 8, and 3, 6, 9, 12.

The existence of cycles depends upon the existence of repetents, or terms which multiplied by themselves remain unchanged. In the above examples, 1, 6, are the repetents. A cycle is composed simply of roots of repetents, *i. e.*, of terms which raised to certain powers become repetents; or else the cycle (which contains all the powers of any given term) contains an infinite number of different terms.

If a multiplier b leave one term a of a cycle $a, a', \ldots$ unaltered, it will leave every term unaltered. This is evident from the fact that the cycle may be written in the form $a.a, a.a', \ldots$ If the multiplier is a member of the cycle, it is a repetent, for it leaves itself unaltered. A cycle cannot have two different repetents, since either of two repetents of a cycle is the same as their product. The same principle shows that every member is repeated exactly as many times as is the repetent.

The important feature regarding cycles, is that they possess a calculus. All possible products between two cycles form a cycle, and may be called the product of the cycles. Any cycle which is contained within a given cycle is in this sense a divisor of the given cycle; and its order is therefore a divisor of the order of the given cycle. A cycle may be factored corresponding to any factoring of its order; and can be resolved in only one way into factors corresponding to the relatively prime factors of its order.

The index of a cycle is the least power for which every member becomes a repetent, *i. e.*, the least common multiple of the indices of the several members. The index is a divisor of the order and contains all the prime divisors of the order.

There are many properties of cycles which can be much more readily developed from this calculus than in any other way.

Note on Lines of Curvature. By G. Bissing.

[Abstract of a paper read at the meeting of the University Mathematical Association, January 16, 1884.]

Letting x, y, z denote cartesian coordinates and u, v arbitrary parameters, the equations of the developable surface whose edge of regression is the space curve

$$x=f_1(u), \qquad y=f_2(u), \qquad z=f_3(u),$$

are

$$\begin{aligned} x&=f_1(u)+vf'_1(u),\\ y&=f_2(u)+vf'_2(u),\\ z&=f_3(u)+vf'_3(u). \end{aligned}$$

By integrating a simple differential equation the relation between u and v which gives the lines of curvature of this surface was shown to be

$$[f'_1(u)]^2+[f'_2(u)]^2+[f'_3(u)]^2=ce^{-2(u+v)},$$

where c is the arbitrary constant.

PHILOLOGY AND ARCHÆOLOGY.

On K. Brugmann's recent Grammatical Studies. By C. D. Morris.

[Abstract of a paper read before the University Philological Association, May 2, 1884].

An account was given of some recent speculations of K. Brugmann on points of Greek grammar; first as to the use of *πάρος*, sans. *purā*, with the present to represent past time. It was shown that the present tense is essentially timeless; and that it was this timeless character which gave occasion to the employment of the form as the so-called historical present and also as a future, when a point of future time is sufficiently indicated by some other word in the sentence. The second question discussed was as to the existence in languages of the Aryan family of synthetic forms to express relative time; and the conclusion arrived at was that such forms exist only in the pluperfect and future perfect in Latin; being developed there as a consequence of the intrusion of the *s*-aorist into the sphere of the perfect.

The third point treated of was the existence in Greek of the two prepositions *ἐν* and *εἰς*, while the Romans contented themselves with a single *in* in both meanings. It was shown that *εἰς* represents a form *ἐνς*, which arose under the influence of *ἐξ*, the final sibilant of which, though originally having an ablative power, came gradually to lose its significance; and then the constant use in juxtaposition of the notions *into* and *out of* gave occasion to the assumption of a corresponding form by both prepositions; just as *ἐκποδών* (*ἐκ ποδῶν*) suggested *ἐμποδών* and *septentrionalis* occasioned *meridionalis*. The last and longest of the discussions was on the particle *ἄρα*. Its uses were clearly traced, and it was shown that the Lithuanian particle *ìr* exhibits a remarkable correspondence with them. Brugmann acquiesces in the old connection of this particle with the root of *ἀραρίσκω*. It may be worth while to give here in outline the uses of *ἄρα* (*ìr*) as they are developed in this paper, with a single reference for each. *Ἄρα* expresses

I. Coincidence or Correspondence.
  (*a*) in time, Z. 515: in place, A 149: in quality, A 158: in
    P. 266.
  (*b*) between charge and execution, between assertion and fac
  (*c*) between detailed statement and subsequent summary, T. 1
  (*d*) between conclusion and premises, H. 360.
  (*e*) between cause and consequence, A. 56.
II. Immediate sequence or concatenation.
  (*a*) in time, B. 103.
  (*b*) in consequence, Θ 397.
  (*c*) merely in the conception of the speaker, the real order b
    ferent, B. 621.

These last, however, run so closely together that it is not pra
classify the examples with certainty.

A Study of Dinarchus. By E. G. Sihler.

[Abstract of a paper read before the University Philological Association, M

Having glanced at some curious analogies in the rhetorical car
first and the last of the ten Attic orators, and having noticed the
Dinarchus even in the times antedating Dionysius, the author g
sketch of the life of Dinarchus, mainly from Dionysius; for the d
are original in the *vita* (in X oratt. vitt.) are loose inferences.
laid on the removal of Aeschines from Athens in consequence of
of Ctesiphon's trial,—whereby the most eminent competitor of
was eliminated from the political and forensic field. It is curious
after the Macedonian and oligarchic reconstruction of Athens in 3
chus did not obtain the franchise; Dinarchus' appearance against
his friendship with Demetrius of Phalerum, and his subsequent b
in the anti-Macedonian reaction of 307 B. C., justify us in making
ence that the politician in Dinarchus was well expressed, while
rently (fragm. 86, Müller) was satisfied with the wealth and presti
by him in a purely professional capacity.

A number of the more elaborate *periods* of Dinarchus were sy
analyzed and anacolutha were pointed out in several of them, t
which observation goes far to vindicate the MSS. reading in tw
passages (c. Dem. 5, *ἡ βουλή*—and c. Philoch. § 18 fin. where Ma
the Zurich editors assume a lacuna).

In *σύνθεσις* a conspectus was given of Dinarchus' use of hyper
of the postponement and emphatic position of telling words and
the Demosthenean vein, also of *λέξις κατεστραμμένη*, of *ἀναδίπλω*
δεινότης λέξεως, *i. e.* the choice of strong or strange expressions. In
of vituperative epithets it was shown through a parallel with
that Dinarchus remained entirely within the limits of established
Considerable skill was conceded to Dinarchus in his manip
anaphora in the frequency of which he goes beyond both De
and Aeschines. Finally it was shown that there is little orig
Dinarchus' choice of ideas and rhetorical argument.

The endeavor was made to give everywhere a tolerably exhau
spectus of passages illustrating the several points of rhetorical
(This paper is the expansion of an essay prepared for the Johns
Philological Seminary, during the session of 1877–78).

Parallelism in Beowulf. By C. B. Wright.

[Abstract of a paper read before the University Philological Association, Apr

The parallelistic feature of Anglo-Saxon verse is in no respect
a perfected tendency is coexistent with the earliest poetic impu
permeates the poetic mass. In the Beowulf saga the phenom
finished as it is frequent; at the close of the tenth century it is st
vigorous expression in the story of Byrhtnoth's death. In the
adequate treatment of so marked a poetic factor, the paper seeks
the parallelistic scope by a detailed examination in Beowulf of i
verses.

Synonymous parallelism, in its various modifications, embraces a majority of the completed forms; a type is furnished by vv. 124–5:

. . . thanon eft gewât
hûðe hrêmig tô hâm faran,
mid thaere wäl-fylle wîca neósan.

Parallelistic antithesis is of comparatively rare occurrence, the Anglo-Saxon mind, uninfluenced by external usages, being but little in harmony with adversative forms. The present section contains but three genuine, antithetically balanced parallels, viz.: vv. 20–23, 109–10, 183–8. Throughout the body of Anglo-Saxon verse, a majority of these rare antitheses appear to be connected with the antithetical ideas involved in future reward and punishment; the exceptional occurrence of five examples in the first 75 verses of Genesis apparently results from the nature of the subject — the original glory of the fallen angels and their condemnation to the abodes of hell.

If $(A)\left\{\begin{matrix}SVM\\SVM\end{matrix}\right.$, (subject, verb, modifier), be the normal form of a parallelistic couplet, it cannot be questioned that $(B)\left\{\begin{matrix}SVM\\S(V)M\end{matrix}\right.$, involving the suppression in the second member of a verb synonymous with that contained in the first, is subjectively legitimate as well; *e. g.*, vv. 55–6:

. . . fäder ellor hwearf,
aldor of earde . . .

Disintegrating the second member still farther we enter the region of synonymous words and phrases. Two forms result, $(C)\left\{\begin{matrix}SVM\\S(VM)\end{matrix}\right.$ or $\left\{\begin{matrix}SVM\\(SV)M\end{matrix}\right.$, according as the remnant of this mutilated second member is synonymous with the subject or with the modifier of the first; these two forms are shown respectively in vv. 349–50:

wäs his môd-sefa manegum gecŷðed,
wîg and wîs-dôm: . . .

and vv. 119–20:

. . . sorge ne cûðon,
won-sceaft wera.

We have clearly passed the limits of parallelistic form; have we passed the limits of parallelistic tendency? The formulated series, (C), (B), (A), is a uniformly progressive one; shall we go too far in assuming that its various factors, (C) as well as (A), are the outgrowth of a single predilection?

On the Dialectic Equivalence of *n* to *š* in Proto-Babylonian. By CARL F. LEHMANN.

[Abstract of a paper read before the Society for the Study of Shemitic Philology, March 24, 1884].

There are two cases in which the equivalence of *n* to *š* in Proto-Babylonian seems certain:

1. Sumerian *šar:* Akkadian *ner* (Assyrian *šarru*) "leader," "king." Also in Sum. *šer-mal:* Akk. *ner-gal* "king," "ruler" (literally "being leader").
2. Sum. *a-šera:* Akk. *a-nera* "to lament" (probably a compound of *a* "water" and *še-ir* "to lament," "to sigh").

W. A. I. IV. 9, 32a *mun-gi-eš*, upon which the assumption of a third case (Sum. *geš*, Akk. *gen*) had been based is now differently explained by Dr. Hommel in *Die Semitischen Völker und Sprachen*, vol. I, page 511, line 3 ff.

This correspondence was first pointed out by Professor Haupt (see "*Der Keilinschriftliche Sintfluthbericht*," page 25, note 16 and the passages quoted there). It is unexplained as yet (cf. Hommel: "*Die Semitischen Völker und Sprachen*," vol. I, p. 289). The following suggestions may perhaps be found acceptable:

Traces of Rhotacism appear in Sumero-Akkadian, Akk. *šeš* and *šer* to sigh, *e-eš* and *e-ir*, Ass. *bakû*, to weep. (Haupt, *Keilschrifttexte I*, p. 36, Nos. 865, 866). If then *r* is assumed as an intermediate stage between *š* and *n*, the only difficulty, that remains, is that of arriving at *n* from *r*.

A certain relation between *n* and *r* must have been assumed by those who admit the interchange of these two liquids in consequence of dissimilation, as in Aramaic *tĕrên* for *tĕnên* (Hebr. *šĕnayim*), Lithuanian *Mangarytà* for *Margarytà*.

Moreover there is no organic difficulty in the formation of a nasal *r*.—In Proto-Babylonian a phonetical correspondence of *n* to *r* can be shown: The word for "plantation," "garden" is *gan* as well as *kar;* both appear in Assyrian as *ginû* and *kirû* respectively.

Furthermore, the Assyrians pronounced the name of the city, called *Erech* in the Old Testament, *Uruk*. In Akkadian its name is, as a rule, written ideographically, phonetically only once: *u-nu-ug* = *Unug*. Variations in the Akkadian pronunciation of this word cannot, therefore, be directly traced. It is highly probable, however, that in parts of ancient Babylonia the pronunciation was really *Urug*, whence the Assyrian form is derived. (See A. S. K. T. 1, p. 19, Nos. 330, 331, and compare especially 334.)

There is nothing, then, to prevent the conclusion that a nasal *r* forms the intermediate stage between *š* and *n*.

As variations do not occur in the two dialects alone, but also within each one of them (cf. Akkadian *ner* and *šaš* in comparison with Sumerian *šer* in *a-šera*), we possibly have to do with original coëxistence, and not with the development of one form out of the other.

The two words discussed here, show the correspondence of *n* to *š* in the beginning of a syllable and end in *r*. Dissimilation may therefore be the reason of the non-appearance of the intermediate form with *r*.

Rhythmical Pronunciation of Greek and Latin Prose and a few remarks on Accent. By C. W. E. MILLER.

[Abstract of a paper read before the University Philological Association, April 4, 1884].

By the rhythmical pronunciation of *any* language is meant its pronunciation as regards the *ictus* (stress) or *ictuses* of its words, when pronounced alone or in combination with other words. It is called *rhythmical* because on it *rhythm* in versification depends. This paper endeavors to point out the principal features of the correct rhythmical pronunciation of Greek prose, and to give some suggestions in regard to that of Latin; a few remarks on accent are added.

We postulate the principle that the versification of a language must be in accordance with the nature of the language. This amounts to saying that ictus in verse must depend on the same principle as ictus in prose.

We consider:

I. *Greek.*—It follows from the above postulate that the Greeks were able to read their rhythms correctly without a knowledge of the scansion. If this is true, the Modern-Greek method and the English method of pronouncing the prose of classic Greek are absolutely wrong, since, when applied to verse, they will not, except in very rare cases, enable one to read a single line of poetry without violating the rhythm.

The question now arises as to how we are to get at the correct pronunciation of classic Greek prose. We have seen above that ictus in verse is governed by the same principle as ictus in prose. Hence, if we know the principle that governs ictus in verse, we know that which governs ictus in prose. Now the fundamental law of Greek rhythm was found upon investigation to be the following: *A long syllable either preceding or following a single short syllable or two (not more) short syllables, must have the ictus.* This rule has no real exception in the ordinary rhythms, the only violation of it, occurring in the highly artistic form of the Dochmiac: > ¦ ⏑ ⏑ — $\overset{>}{\smile}$ | — ∧. Here the first long is followed by two shorts and ought to have the ictus, which it would certainly have in prose. To the other parts of the rule, no exceptions are known to us. This fact seems to be a corroboration of the statement that Greek is an iambic language. It may account for the absence of the following four forms of the dochmiac:

⏑ ¦ — ⏑ ⏑ > | — ∧
> ¦ — ⏑ ⏑ > | — ∧
⏑ ¦ — ⏑ ⏑ > | ⏑ ⏑ ∧
> ¦ — ⏑ ⏑ > | ⏑ ⏑ ∧.

The following law, depending upon the one given above, embraces the theory of the irrational long:

An ictus-lacking long syllable either preceding or following an ictus-bearing long is irrational.

These two laws may be summed up in the following general law:

A long syllable either preceding or following a single short, an irrational long, or two (not more) short syllables, must have the ictus.

Apply these rules in the pronunciation of Greek prose and you will approach very closely the rhythmical pronunciation of the ancient Greeks.

II. *Latin.*—In the case of Latin, it is still an open question whether the system of versification embodied in the large mass of their poetry is indigenous or merely an imitation of the Greek. All indications seem to point to the former. The versification of Plautus and Terence is so very distinct from the Greek that it is very difficult to see how it could be an imitation of it. Excepting, perhaps, that part of the fundamental law of Greek rhythm, which prescribes that a long followed by a single short must have the ictus, every other part is very frequently violated. To get an idea of the striking difference between Latin and Greek versification, one need but write out the scansion of fifty senarii of Plautus or Terence and compare them with fifty senarii of Aristophanes similarly written out. A marked characteristic of the Latin is the irrational Anapæst ⏑́⏑ >. Another feature not to be overlooked is the remarkably frequent concurrence of word accent (pitch) and verse ictus (stress). This latter phenomenon would tend to show that in prose too, the concurrence of word accent (pitch) and word ictus (stress) was very frequent. Upon the whole, it is probable that the Latin language represents a state of transition from what is commonly called a *quantitive* language to what is commonly but *incorrectly* called a *rhythmical* language.

The only way to get a satisfactory and the quickest possible solution of this difficult problem is for one competent person to investigate the whole field of Latin versification and not limit himself to a special study of the Saturnian Verse, or of Plautus, or Terence, or, in short, of any single author or single rhythm.

Remarks on Accent.—There are four factors which enter into the pronunciation of a syllable; viz., quality, quantity, stress, and pitch. Now, since accent is independent of quality, quantity, and stress, and since the Greek names of the accents show their connection with pitch, we have adopted the theory that was proposed years ago, that accent is pitch; but it is not a musical pitch, such as is produced by the voice in singing.

On Inchoative or N-Verbs in Gothic and other Germanic Dialects. By A. E. Egge.

[Abstract of a paper read before the University Philological Association, May 2, 1884].

This paper was an attempt to point out the fundamental difference in Gothic and Scandinavian between the inchoative verbs, and passive and neuter verbs, as well as a criticism of several inaccurate statements and mistakes in regard to the subject in various English and German text-books. Thus, on p. 336 of Morris and Skeat's Spec. of E. E., Pt. II, in a note to l. 179 of "The Bruce," the editors say: "The introduction of the letter *n* renders a verb intransitive in Moeso-Gothic, Swedish, &c. Thus we have Sw. *vaka*, to watch, *vakna*, to awake." This is inaccurate and misleading. The verb quoted, *vaka*, is itself intransitive, and the adding of an *n* can therefore not *make* it intransitive; but this *n* makes verbs *inchoative*, changing the meaning in the case of *vaka* and *vakna* from "to be awake" to "to become awake," and when used to form verbs from adjectives, it signifies the entering into the state or quality expressed by the adjective (cf. *kvitna*, *sjukna*). Another misleading statement is found in Skeat's Etymol. Dict., in the otherwise valuable note to the word *awaken*. Mr. Skeat says: "In this suffix [*i. e.* -nan], the first *n* is formative, and conspicuous in both Moeso-Gothic and Scandinavian, in which language it is used to render a verb *intransitive* or *reflexive*." Some examples were then given to show the difference between inchoative and passive verbs in Danish. Thus the inchoative *vaagne* can only be used when no agent is expressed, or when the instrument or cause is a dead thing or a force (*aliqua re*), while the passive *vækkes* may be used either with a person (*ab aliquo*) or thing (*aliqua re*) as the logical subject. Thus I may say either *jeg vækkes* or *vaagner of stormen of tordenen*, but only *jeg vækkes of min broder*, not *jeg vaagnede of min broder!* This is a pervading principle in the Scandinavian languages, and it applies equally well to Gothic, which is exceptionally rich in *n*-verbs. W. Braune's statement (on p. 75 of his Goth. Gram.) is therefore unsatisfactory, as it does not indicate clearly enough which are the more truly passive, the *n*-verbs or transitive verbs in the medio-passive voice. The false definitions of *gadauthnan* by Braune (p. 75) as = "to be killed," and of *gawaknan* by Skeat (Moeso-Goth. Gram. and Glos., and Spec. of E. E., Pt. II. under *valknyt* and *wake*) as = "to be awake" were referred to and corrected.

A full list of all Gothic nan-verbs was presented, together with references to the places where each occurs, and parallel forms from Old and Modern Norse. The great majority of them (about ⅚) are inchoative, while the few others are simple neuter verbs, at least as regards the examples in which they occur. In regard to *infeinan* and *uskeinan*, which by J. Grimm and others are classed with the inchoatives, the fact was pointed out that in every inchoative verb in Gothic (with the single exception of *gakwiunan*) and Scandinavian, there is a consonant before the *n*, which, besides what W. Braune states (p. 75, n. 2 of his Goth. Gram.), might be regarded as an additional reason for not referring these verbs to the class of inchoatives. *Fraihnan* and *maurnan* (A. S. *frignan*, *meornan*) were thought not to belong here because they form their pret. and p. p. as strong verbs, while all genuine inchoative verbs are weak.

In regard to the note by Gabelentz and Löbe (II², p. 138, 3, n. 1) where they say: "Oft kommt das Passivum neben diesen Wörtern dritter Conjugation von demselben Stamm vor, ohne dass ein wesentlicher Unterschied nachgeweisen werden könnte," etc., and adduce several examples to prove their theory, the belief was expressed that in each case a distinct difference must have been felt by the Gothic language-user, and in regard to most of the examples quoted in the note referred to, an attempt was made to show what this difference is. Thus, to take one example, it is quite easy to feel the difference in meaning between the two verbs in *Christus mērjada* (1 Cor. 15, 12), "Christ is preached," and *usmērnôda thata waurd bi ina* (Luc. 5, 15), "the fame of him went abroad" (the Greek in the first sentence has *κηρύσσεται*, in the second *διήρχετο*). If the last sentence had been "the fame of him was noised abroad by the people," the Gothic could not have been *usmērnôda thata waurd bi ina fram thizai thiudai* but the passive of *usmērjan* would have been used.

A list of Norwegian *n*-verbs was given together with a brief statement of the formation and use of *n*-verbs in the Scandinavian languages. In regard to Anglo Saxon the statement was made that it must also once have had a distinct class of verbs of this kind; but the introduction of an *i* or *j* after the *n*, making them look like verbs in *-jan* or *-njan*, where *j* and not *n* is the formative element (cf. *äfnian*, *beacnian*, etc.) seems by analogy to have brought about a corruption of meaning as well, rendering most of them transitive. Here we find perhaps also the explanation of the fact that in mod. Eng. all verbs in *-en*, whether lineal descendants of old inchoative verbs or new formations made on the analogy of these, are one and all factitive. A list of inchoative verbs in Anglo-Saxon and Early English was given, together with a number of references to places were they occur.

The name "inchoative," which is used only by Wimmer (Altnordische Gram., übersetzt v. E. Sievers, p. 127 top), was regarded as a better name for n-verbs than either "intransitive" or "passive," used by other authors, as it is evident that the majority of the verbs in question are strictly speaking neither, but answer in meaning very closely to the inchoative verbs in Latin and might with the same right as these be called inchoative.

The City of Harran: Notes on its Name and History.

By C. Adler.

[Abstract of a paper read before the Society for the Study of Shemitic Philology, December 13, 1883].

The Biblical Harran, Κάῤῥαι, Carrae, a locality famed for the defeat of Crassus, has always been a place of peculiar interest. The early Hebrew lexicographers are silent about it. The more modern ones (Gesenius and Fürst) derive the name from חרר, "to scorch, to burn." But Harran is not a scorched, burnt place. The Biblical reference to wells, etc., the character of the place as a station for caravans, a market, or both, Pliny's description, and the reports of travellers like Chesney, serve to show that Harran was, at one time, one of the most flourishing cities of Asia. In a communication to the London Athenaeum (April 19, 1862), Sir Henry Rawlinson suggested that the name of the place was derived from the Assyrian word for road *harranu*, and based his argument on the well-known character of the place as a public highway. This has finally been adopted in the 9th edition of Gesenius (Mühlau & Volck) as a possible derivation. Harran is mentioned seven times in Genesis, in II Kings 19:12, do. 37:12 and Ez. 27:23; Ptolemy, Strabo, Chwolsohn, and Dean Stanley all practically agree as to its location. They place it in about latitude 36°, in Mesopotamia on the river Belik, identifying it with Greek Κάῤῥαι. Dr. Beke, as early as 1834, doubted this, and from November, 1861 through to May, 1862, a controversy raged on the subject in the *Athenaeum*, Prof. Porter, Dr. Beke and

Sir Henry Rawlinson taking part. We can, however, conclude with Dean Stanley that this discussion left the question where he found it, and that no rguments have been advanced to cause us to abandon the above mentioned ocation of Harran.

A diligent search among early Jewish writers was not rewarded by the iscovery of any traditions concerning the place. The Syriac Chronicle ontains a legend that the city was founded by Arpahschad, the grandson f Noah. According to one of the Arabic Chronicles, Laban built the town. aqut asserts that it was the first place built after the flood. Judging from he Biblical account alone, we would conclude that Harran was a very ncient city. There Terah died. There Abraham stayed, and he came way with an increase of property and especially slaves, a circumstance that as led many to infer that Harran was a slave market. Jacob fled thither Laban. After this we lose sight of it until the time of Hezekiah when it taken by the Assyrians. Again it passes out of sight, though Chesney serts, without giving his authority, that Alexander the Great passed rough the town during his campaign in Asia, until we find it appearing Roman history (Plutarch, Ammianus and Dio-Cassius) as the scene of e annihilation of the army of Crassus. Under the Empire we find that aracalla was assassinated on the road from Edessa to Carrae, whither he as going to worship the moon-god. In more modern times the place is oted for its obstinate adherence to paganism. The Christians were few, nd we find several of the Christian Bishops speaking of the people a godless race. As late as the VIIIth century, according to Abu usuf el Qathi, it was customary to offer human sacrifices. The victim as generally a man of good reputation and handsome appearance, and fter the sacrifice his head was cut off and used as an oracle. It is difficult make any definite statements concerning the inhabitants of Harran. hwolsohn and Sir Henry Rawlinson are inclined to think that it was habited by כסרים, an Arian or Iranian race, whom the former identifies ith the Kurds. Rawlinson finds some difficulty in identifying the כסרים ith the Χαλδαῖοι, though, as everyone knows now, the interchange between and *l* is one of the commonest of the Assyrian phonetic laws.

Christian Mosaic-painting in Italy (IV to XIV Century).

By A. L. Frothingham, Jr.

[Abstract of a paper read before the University Archæological Society, May 9, 1884].

Mosaic-painting from its permanent and unchangeable character is one of e most valuable branches of Christian archæology. Of the three kinds sed by the Romans—the *opus sectile*, *tessellatum* and *vermiculatum*—the latter nly was used for wall-mosaics, which are here in question. This species as formed of minute cubes of marble, composition or glass paste, of innuerable shades. The artificially-made cubes came more and more into use fter the fifth century. The artist himself made his cartoons, selected his ubes, drew his outlines on the wet mortar and then filled them in accordg to his colored design. Christian art very early made use of mosaics: umbers existed in the catacombs of Rome and Naples belonging to the fourth nd fifth centuries. When Constantine caused magnificent basilicas to be built roughout the Empire, mosaic-painting, which unites perfectly with archicture, was employed almost exclusively for their decoration. The two reat schools which then arose in Italy were those of Rome and Ravenna: th preserved much of the classical style down to the sixth century. In ome this was combined with a strong naturalistic tendency, while in avenna there were two currents, the Latin and the Greek, the latter of hich finally prevailed at the time of Justinian. Other schools of minor portance were at Naples, Capua, Milan, and Vercelli. The iconoclastic ovement caused an influx of Greek artists to Rome, where among their holars there arose an Italo-Byzantine style of mosaic-painting which came debased and died out in the ninth century.

After a blank of about two hundred years a revival of mosaic-painting ok place in Italy: this was due to the importation of Greek artists, some whom were established at Monte-Cassino (in 1066) and others at Venice. he Greek influence produced different effects according to the schools it fected: in Sicily the style was more oriental, in Rome more blended with assical reminiscences, in Venice more energetic and varied, yet predomintly Greek. At Rome the school of the so-called Cosmati marked a vival of the mosaic art, preceding the Tuscan, and produced works of great interest. The Tuscan school was derived from the Venetian and took a prominent part at the time of the great revival in painting at the close of the thirteenth century: the works of Jacobus Torriti in Rome and those in the Baptistery of Florence are worthy of admiration. Although such great artists as Cimabue, Duccio, Gaddo Gaddi and even Giotto were mosaicists, yet the new departure taken by Giotto gave such a preference to the more naturalistic form, fresco-painting, that mosaics rapidly fell into disuse, and the mosaicist, from being an artist, fell to the rank of a mere artisan to whom designs were furnished by painters of note. This kind of work flourished in Rome and Venice for several centuries.

BIOLOGY.

The Significance of the Larval Skin in Decapods.

By H. W. Conn.

[Abstract of a paper in the *Studies from the Biological Laboratory*, Vol. III, No. 1, March, 1884, with two plates].

The article contains a discussion of the phylogenetic significance of the peculiar structure enclosing the embryos of vertebrates known as the larval skin. This skin, being probably of no physiological importance, is, therefore, particularly valuable in its morphological significance. A number of new types of larval skin are described; (Callinectes Sesarma Pinnotheres): and it is shown that there is a complete and graduated series beginning with a form like Panopeus, where the larval skin is a highly complex structure with many feathered spines and ending on a form like Pinnotheres where the cuticle is nothing more than a larval covering with no spines. In general also it is found that the more complex larval skin is found in crabs, which stand low in classification, while the simple larval covering is found in more highly organized Brachyura; a condition of things just as we should expect from the consideration that this structure represents the ecdysis of some stage in the crab development earlier than the zoea. It is further shown that such an earlier stage was probably a protozea and that we, therefore, have here strong evidence that this stage was formerly included in the ontogeny and therefore in the phylogeny of the Brachuray. Finally, it is argued that evidence is here obtained tending very strongly to show that the Decapod zoea is simply a larval form which has never been represented in the phylogenetic history of the group, contrary to what has been claimed by Müller, and later in a different form by Balfour.

On the Life History of Thalassema. By H. W. Conn.

[Abstract of a paper in the *Studies from the Biological Laboratory*, Vol. III, No. 1, March, 1884, with one plate].

The article contains a brief account of the more important points embodied in a larger paper not yet published. They are as follows:

1. Origin of ova and spermatozoa as modified peritoneal cells, their growth in the body cavity as independent cells, and their preservation in a sexually mature condition in the sexual pouches.
2. Protrusion of two polar globules exhibiting a rhythm similar to that of the segmenting ova.
3. Segmentation, which is perfectly regular, forming an exception to Annelids in general.
4. Formation of gastrula by a typical invagination.
5. Early appearance of a preoral band of cilia, and its subsequent disappearance and replacement by a *row* of longer, more powerful cilia.
6. The transformation of the gastrula into the trochosphere by a peculiar method of growth.
7. Origin of mesoderm is two-fold and the segmentation of mesodermal bands.
8. Origin of ventral nerve chord from the ectoderm as a bilateral structure.

The Coagulation of Blood. By W. H. Howell.

[Abstract of a paper read at the meeting of the University Scientific Association, April 2, 1884].

According to the theory of Hammarsten the fibrin of coagulated blood is formed from the fibrinogen alone of the plasma under the influence of the fibrin ferment. While according to the older, and, at present, more generally accepted view of Schmidt, paraglobulin or fibrinoplastin is a necessary factor in the formation of fibrin.

Hammarsten's experiments were made upon the blood of mammals, and, so far as I know, have never been corroborated by any other investigator. A desire to test the correctness of Hammarsten's theory upon one of the lower animals led me to a series of experiments upon the blood of the terrapin, similar to those made by him upon the mammal. The blood was received directly into a glass cylinder packed in ice, and allowed to stand for one or two days. At the expiration of that time the corpuscles had settled to such an extent that a quantity of clear plasma equal to about two-thirds of the original bulk of blood could be siphoned off. This plasma was filtered, to free it from white corpuscles, and the fibrinogen then precipitated by the addition of an equal volume of a saturated solution of NaCl. The precipitate was filtered off, dissolved in dilute NaCl solution, and the process of precipitation repeated three times in all. The final precipitate was dissolved in distilled water, and gave a solution of fibrinogen which contained not a trace of paraglobulin. When an aqueous solution of ferment, prepared by Schmidt's method, and likewise entirely free from paraglobulin, was added to the fibrinogen a firm clot was obtained in all cases. The amount of fibrin formed from the fibrinogen under the action of a powerful ferment was, according to one experiment, 69 per cent.

The solution of fibrinogen was sometimes slightly opalescent, sometimes perfectly clear. When heated to 56° to 60° C. a complete coagulation occurred, the liquid when filtered from the finely granular precipitate and boiled, showed, usually, not the slightest opalescence. In some cases a very faint cloudiness was observed. The action of my fibrinogen solution differs markedly in this respect from that obtained by Hammarsten from the mammalian blood. According to him only a portion of the fibrinogen, 65 to 91 per cent., coagulates at this temperature, the remainder staying in solution as a new globulin, and coagulating at a temperature of from 64° to 65° C.

On the Molluscan Gill. By H. L. Osborn.

[Abstract of a paper read before the University Scientific Association, March 5, 1884].

Peck and Mitsukuri have elucidated the Lamellibranch gill and given reason for believing that it is not, primarily, the highly complex organ it is in most of the present Lamellibranch forms but that this complexity is secondary; that in its simplest form, as shown by its comparative anatomy in adults and by its embryology, the gill is to be considered as a row of successive folds of the inner wall of the mantle entirely free from one another.

Studies of the prosobranch show that we have here a form of gill which is almost precisely like that which we must consider primitive in the Lamellibranch. Fusus, Neverita, Littorina, Eurosalpinx, Segaretus, Crepidula are all very closely similar. Their gills consist of a row of plates which are folds of the inner wall of the mantle hanging down freely into the mantle cavity where they are bathed continually with water. Such a form of gill is the form almost universally present in a very large majority of the prosobranchs. Its larval history shows that it arises as a series of ridges in the mantle-wall which increases its surface and its later history is briefly, a direct growth into the very simple adult condition. The habits of the creatures, locomotive and aquatic, as we should suppose those of the earliest ancestors to have been would tend to preserve the gill in its primitive condition, while the sedentary habits of life which have been adopted by the Lamellibranchs indicate that we must expect in their organization to find many special adaptations.

It is therefore thought that in this resemblance between the gills of the prosobranchs and the least specialized gill of the Lamellibranch we have additional ground for the view which has been suggested by Brooks and Lankester (Article "Mollusca" in Encyclopedia Britannica) in opposition to all text-book doctrine that the Lamellibranchs are not the ancestors of the gasteropods but are degraded forms that have originated from the gasteropod stock if not actually from any cephalous mollusk.

HISTORY AND POLITICAL SCIENCE.

Congressional Government. By Woodrow Wilson.

[Abstract of two papers read before the Seminary of Historical and Political Science, May 9 and 16, 1884].

These two papers constitute the first two essays of an extended study of Congressional as contrasted with Parliamentary government. In the first paper, which is introductory to the more special and technical chapters which follow it, those tendencies of constitutional construction, those precedents of actual governmental practice, those phases of national thought upon questions of administration, those conditions of society, and those indications of future development were brought together which have caused the original, ideal balances of the theory of the Constitution to give place in the actual conduct of the federal government to a constitutional system, which, much broader, even in principles, than the Constitution itself—though still resting firmly upon that Constitution as its foundation,—knows the federal government, not as a power coördinate with the State governments, but as a power greater than they, both actually and potentially, and Congress as supreme director of national policy, to the overshadowing of both the prerogatives of the Executive and the privileges of the Judiciary. Under such a system Congress is, of course, properly the central figure of constitutional study. To know its methods of procedure and its ways and means of overseeing and directing the course of affairs is to know the most essential machinery of our national government; and, in order to know these things, one must see Congress from the inside.

In the second paper this inside view of Congress was exhibited in a sketch of that device of organization whereby the House of Representatives divides its work, and its functions of deliberation, amongst more than forty Standing Committees to whom go, as of course, all bills introduced, from whom emanate all the propositions that are vouchsafed consideration or advanced to action, and in whose hands, consequently, are the direction of business and the control both of debate and of conclusion. The peculiarities of this plan of Committee government were emphasized by extended contrasts with that other system of government, called "parliamentary," in which the powers given the Committee of the House of Representatives are conferred upon ministers who are also the advisers of the Executives;—a system which may be said to be the prevailing governmental fashion of the world. Of this system the British House of Commons is, of course, the parent type, though for the purposes of this essay, and for the sake of more varied illustration, the French constitution was put by the side of the British as a leading example of that plan whereby the heads of the Executive departments are made the leaders of the legislative majority, thereby securing a government characterized by free debate and a well-defined party policy. Parliamentary government is direct party government, Congressional government, indirect; in the one, responsibility rests upon a compact ministry all of one party, in the other, upon a disintegrate ministry of Committees which are made up of members of both parties and all factions, and which, unlike the ministry of the other system, do not come into direct contact with the practical affairs of administration. In the one the best, the picked men, lead; in the other, all, the weakest as well as the best, have a hand in leading, every member of the House being a member of one or other of the Standing Committees. In Congressional government, moreover, the decisive contests of legislation take place in the privacy of Committee rooms, whilst under Parliamentary government those contests of necessity take place in public, upon the floor of the legislative body. Unlike, however, as these two systems are, they are kin in representing a common effort to set up some such "legislative commission" as J. S. Mill proposed, whereby a numerous assembly, itself radically unfit to make good laws, can get good laws made. We have more than forty such commissions [illegible] Great Britain, only one.

ounty Government in Virginia. By E. INGLE.

tract of a paper read at a meeting of the University Historical and Political
e Association, April 18, 1884].

twithstanding instructions to governors for setting up different forms
vernment in the colony, no county was created before 1630. The
tled condition of the public mind, the gathering together of people
'great families," after the Indian massacre, caused extensive powers to
anted to the commissioners, who combined in themselves military and
jurisdiction. But in 1634 there were created eight shires which were
governed as shires in England with lieutenants, elected sheriffs, ser-
s, and bailiffs. That these counties as a rule were named from and
aced local settlements is a curious phase in our institutional history,
t was nothing more or less than towns growing into counties.
ing was originally along the rivers and was confined to a small area.
dian panics became less frequent, people ventured forth beyond stock-
and gradually went away from the towns. New planters came in and
d at once in remote parts. Population thus became too scattered to be
by a few military leaders. The complications arising from new
tions,—the importation of servants, the introduction of negro slaves,
he settling of new land, necessitated a court and public functionaries to
e harmony. The wishes of the original settlers had great influence in
election of the sites for court houses, so that in the older counties some
itants were often greatly inconvenienced by having to travel many
to attend court. In the newer counties attempts were made to place
ourt houses as near the centre as possible; but as long as population
ined in cis-montane regions, there was a tendency to seek the river
s for sites. The great point to be remembered is that, at first, counties
the outspreading of towns, not that towns, as later, were the aggre-
n of the people in a county seeking a place for the transaction of
ess. The rest of the paper was devoted to a study of the militia,
y courts and their officers, and the other institutions of the county.

amuel Adams, the Man of the Town-Meeting.
AMES K. HOSMER.

tract of a paper presented to the Seminary of Historical and Political Science
4, 1884].

New England, strong Celtic and, of late years, French Canadian ele-
s have affected in many parts the character of the Town-Meeting. To
it, therefore, at its most characteristic stage, we must go back from
resent. We must take it, too, at a time when the country had become
neasure developed. The intermediate epoch is that of the Revolution.
sely then it is that we can, to most advantage, examine the American
note. The town especially deserving of study is Boston. There the
-meeting was most vigorous; the folk who carried it on were more
rous and intelligent than elsewhere; the events that flowed from its
ty were the most momentous ever proceeding from such an origin. In
hole history of the Anglo-Saxon race, in fact, there have been no such
sting manifestations of the Folk-mote as in the Boston of the Revolu-
from it came the independence of America. In the Revolution,
achusetts led the thirteen colonies; Boston led Massachusetts. Who
e town of Boston? There are several conspicuous figures, men who
gh ability and character had influence in the town-meeting; but the
olling-mind was that of Samuel Adams. Others surpassed him in
kinds of ability, but no one was so admirable as a manager. His
dency was marked; he was far-seeing and could combine men and
ge measures so as to secure great ends. He, first in the thirteen
ies, proposed a Congress looking toward a resistance to British encroach-
, the Stamp Act Congress of 1764. Through his scheme of Commit-
f Correspondence the New England towns were combined. Though
inia took the lead in the matter of intercolonial Committees of Corres-
ence, the incitements from New England had no doubt influenced her.
of Americans, Samuel Adams looked and labored for independence.
nd all other men, he is "the type and representative of the Town-
ing." Though in various other positions of influence, the sphere he
was the Town-meeting, there he accomplished his most memorable work, for that he was best fitted. In the democratic rule of the Town-meeting he thoroughly believed, carrying to an excess his dislike of delegated power.

E. A. Freeman remarks that in some of the American colonies "representation had supplanted the primitive Teutonic democracy which had sprung into life in the institutions of the first settlers." Over vast areas of our country at the present time representation has supplanted the primitive democracy. Yet in order that a representative system may be well managed, there ought to be, below all, the primary meeting of the individual citizens, discussing and deciding for themselves local affairs. It is too much, perhaps, to expect that the Folk-mote can be generally revived, but it is well to study the Town-meeting as it has been, and the figure so closely identified with it.

Sir George Calvert, Baron of Baltimore. By L. W. WILHELM.

[Abstract of a paper presented to the Historical Seminary, March meeting, 1884].

George Calvert, the founder of the Baltimore family of the Irish peerage, will find a permanent place in English history both as one of the chief councillors of James I., and as one of the pioneers in settling the English colonies in America. Although a strenuous advocate of the Spanish Match and a leader of the great Spanish party which was demoralized by the tactics of Buckingham, Calvert's claim to recognition has been almost ignored by English historians, but as the settler of the province of Avalon in Newfoundland and as the founder of Maryland, Calvert has preserved for himself enduring fame in the records of American colonial history. No complete biography of the famous colonizer has ever been written. Chapters only in his history have been sketched by Dr. John G. Morris, Prof. E. D. Neill, and the late Hon. John P. Kennedy. While one writer has thrown much light upon Calvert's economic schemes in America, another has devoted at least a third part of his admirable address to prove that Calvert was not converted from the church of England to the church of Rome.

The boyhood of Calvert is obscure. The date of his birth has not been accurately determined, although it was very probably about the year 1580. Born at Kiplin, near Richmond, Yorkshire, he lived, for some years previous to entering Oxford, at the neighboring town of Danby-wiske. The important landmarks in his career were his graduation from Trinity College, Oxford, in 1597, and his visit to the continent in the same year, his appointment to a clerkship under Secretary Cecil, 1603, and as clerk to the crown in 1606. His marriage had taken place in 1604 or 1605; in 1610 he revisited the continent; in 1611 he was appointed register of the garrisoned troops of Ireland and in 1613 was sent to Ireland on two very important commissions; in the same year he was appointed clerk to the Privy Council. He was knighted in 1617 and in 1619 he was made Secretary of State; he held this important office six years, resigning in March, 1625. Calvert's political and parliamentary career ran in parallel lines. In 1603 he was chosen to represent in parliament the borough of Bossinez; in 1621 he represented Yorkshire, and in 1625 the University of Oxford. He was created Baron of Baltimore by King James only a few weeks before the latter's death (March 27, 1625).

From the time of the disgrace of Lord Bacon (1621) to the final rout of the Spanish party (1625), Calvert's duties at Court and in Parliament were extremely arduous, important, and wearisome. As a friend to the Spanish ministers he was extremely obnoxious to Buckingham, and as a strong supporter of the King's prerogative he was thoroughly detested by such impetuous leaders of the Puritans in the House of Commons as Sandys, Philips and Coke. A broad-minded churchman, Calvert became very obnoxious to some of the more narrow-minded clergy. Archbishop Abbot spoke very bitterly about the Secretary, and denounced in caustic terms his conversion to Catholicism in 1625, the year in which he resigned the secretaryship.

Calvert became interested in trading companies very soon after his entrance upon his political career. In 1609 he became a stockholder of the East India Company and subsequently became a member of the London Company (South Virginia) and of the Plymouth Company (North Virginia or New England). Soon after his appointment to the secretaryship, Calvert became much interested in the Newfoundland settlements. He made the purchase of a large tract in the island (1620) and in the following year sent over a small colony of fishermen and laborers. In 1622 he received a grant of the entire island of Newfoundland, but subsequently returned it for the peninsula of Avalon. In 1628 he decided to leave his home in Ireland and to make his permanent residence in Newfoundland, but the severity of the winter drove him to seek a dwelling place in a warmer climate. He reached the Virginia settlements in the autumn of 1629 and was charmed with the beauty of the country and with the hospitality of the people. His religious faith was an obstacle to his permanent residence among the Virginia Episcopalians and in 1630 he returned to England, where he remained until his death on April 15, 1632. Calvert endeavored to secure a grant of land in the territory lying south of the James River, but was thwarted by the opposition of the old Virginia Company.

In the grant of the province of Maryland he probably received the largest land grant in America ever received by a single individual from the English crown. As Sir George had died several months before the charter of Maryland had passed the great seal of England, the history of the settlement of Maryland and its early development belongs to the reign of his oldest son and heir, Cecilius, Lord Baltimore.

State and Local Taxation in Kentucky. By Arthur Yager.

[Abstract of a paper read before the Seminary of Historical and Political Science, April 25, 1884.]

The object of this paper was two-fold; first, to describe the present laws and machinery of taxation in Kentucky, in the light of the most recent developments of financial science; and secondly, to exhibit in their practical operation the local institutions of Kentucky and of the South as these reveal themselves in the administration of the local revenue. In spite of the abundant discussion of local taxation, which has taken place in the United States during the last decade, the field of investigation afforded by the Southern States seems to have been entirely neglected, and the consequent loss to our knowledge of the subject has been considerable. Although the laws, which formulate the state systems of taxation, are fundamentally the same in all the states, yet, owing to the radical difference in respect to institutions, officers, and local machinery, these laws produce very different results in the two great sections of the Union. The centralization of state organization in the South has in an extraordinary degree consolidated into the state-budgets all the most important and productive forms of taxation, while the stationary and uncommercial character of industrial life has reflected itself in the laws for the assessment of property.

In Kentucky about one-third of all the taxes in the state are levied and collected by the state government. In many rural districts the only kinds of property taxation known are those imposed by the state authorities. The unit of administration for financial, as well as other, purposes is the county. The chief financial officers of the county are the assessor and the sheriff, both being elected directly by the people. The assessor is elected for one year only, and is paid upon an average only about six hundred dollars per annum, the method of election, the tenure of office, and the amount of salary producing, as might be expected, great inefficiency in the conduct of the office. There is no state board of equalization, and the most glaring inequalities between different counties and classes of property naturally result.

As regards local taxation, all the ordinary expenses of county government are defrayed by the proceeds of the county levy—a simple poll-tax, imposed and regulated by the County Court. Property taxation for local purposes is not allowed, except in extraordinary cases and by special permission of the legislature. In the administration of the county levy, the sheriff is at the same time collector, treasurer and general controller. This officer presents many points of resemblance to his ancestor, the old English sheriff, both in respect to the multiplicity and vagueness of his powers, and as regards the laws enacted to restrain him. All cities and towns that provide for the maintenance of their own poor and the care of their own streets, are excused from paying their part of the county levy.

It will be seen that the fundamental defects in the financial machinery of Kentucky are inextricably bound up with the fundamental fact in state life, namely, the county, with its various institutions and officers. This same county organization, with all its defects, is the basis of political life all over the South, and with it are indissolubly connected many of the most important questions of public policy, including the educational question and the repudiation question.

LOGIC.

On the Syllogism. By J. Rendel Harris.

[Abstract of a paper read at a meeting of the University Metaphysical Club, April 22, 1884].

The following considerations will, I think, establish that all the valid Aristotelian syllogisms are modifications of a single one.

Let us remark in the first place that to every valid syllogism there belong a pair of related or conjugate syllogisms; for if P, Q, R be the premises and conclusion of a valid syllogism, and if P', Q', R', be respectively their direct contradictories, then $PR'Q'$ is a valid syllogism; for the conclusion cannot be Q, since in that case we could at once deduce R; it must therefore be Q'. And in the same way $QR'P'$ is a valid syllogism.

So far, I believe, we are following De Morgan; but I do not think it has been noticed that these three related syllogisms lie one in each of the first three figures or else they lie all in the fourth.

For example if PQR be in the first figure, which is denoted by

$$\left.\begin{array}{r} Y \ldots X \\ Z \ldots Y \\ \therefore\ Y \ldots X \end{array}\right\},$$

then when we form a syllogism in which the conclusion is the contradictory of the second member, we must make the syllogism take the form

$$\left.\begin{array}{r} Y \ldots X \\ Z \ldots X \\ \therefore\ Z \ldots Y \end{array}\right\},$$

which is the second figure; and so for the other syllogism.

We may then denote our three related syllogisms in the three figures as follows:

	Fig. 1.	Fig. 2.	Fig. 3.
	PQR	$PR'Q'$	$R'QP'$
or	$PR'Q'$	PRQ	$QR'P'$
or	$R'QP'$	$R'PQ'$	PQR ,

the two last being only different ways of writing the first.

In the fourth figure we have a syllogism PQR in the form

$$\left.\begin{array}{r} X \ldots Y \\ Y \ldots Z \\ \therefore\ Z \ldots X \end{array}\right\},$$

and the related syllogisms are evidently $R'PQ'$ and $QR'P'$ both of which are in the fourth figure also.

This establishes the conclusion that valid syllogisms come in three at a time.

But in the next place we observe that to every valid syllogism in each of the first three figures there belongs a conjugate syllogism in the same figure. From what has been said already it is only necessary to prove this for the second figure, since it must follow from this for the other two. Now if we consider a syllogism in the second figure

$$\left.\begin{array}{r} X \ldots Y \\ Z \ldots Y \\ \therefore\ Z \ldots X \end{array}\right\}$$

we observe that since Y does not appear in the conclusion it might have been replaced by anything else, which would disappear in the same manner. Let us then write *non*-Y for Y, or as we may say, introduce privative conception, which has the effect of interchanging A and E propositions, as also I and O. We have thus a new syllogism equally valid (for it is really identical) with the first, which we may call a contrary syllogism to it.

We have now established the conclusion that in the first three figures, valid syllogisms come in *six* at a time. From this we can at once deduce the whole of the common syllogisms.

For consider the following arrangement of syllogisms in each figure.

Fig. 1.		Fig. 2.		Fig. 3.	
AAA		*AOO*		*OAO*	
AII	*AAI*	*AEE*	*AEO*	*AII*	*AAI*
EAO	*EIO*	*EAO*	*EAE*	*EAO*	*EIO*
EAE		*EIO*		*IAI*	

Here the syllogisms placed at corresponding angles of the three figures are mutually dependent, forming a triad of valid or invalid syllogisms, while each syllogism in any figure has a conjugate one at the opposite angle of the hexagon in which it stands.

We now demonstrate as follows: assume, for instance, that *EIO* is valid in any figure, then since *E* and *I* may be simply converted, the syllogism is valid in all figures. And again if *EIO* is valid in any figure so must be *EAO* since *A* involves *I*. From these the figures at once show the whole eighteen syllogisms to be valid.

In the fourth figure the same supposition may be applied to the conjugate triads

Fig. 4.

$$\begin{array}{ccc} & AAI & \\ EAO & & AEO \end{array} \qquad \begin{array}{ccc} & AEE & \\ EIO & & IAI \end{array}$$

And the six syllogisms in this figure are at once proved. It appears therefore that any of the syllogisms may be made to prove all the rest, that the subaltern moods ought to be recognized in the syllogistic scheme; and that the fourth figure has a singular isolation from the other three.

The rejection of the invalid syllogisms according to this method is especially easy: for we have only one figure to examine of the first three. And if we take the second, we proceed as follows:

We cannot have two negative premises, and ∴ we cannot have two affirmative premises which are their contraries:

We can, therefore, have only one affirmative and one negative premiss; *i. e.* either

$$\left.\begin{matrix} AE \\ EA \end{matrix}\right\}, \text{ which give a valid conclusion.}$$

$$\left.\begin{matrix} AO \\ EI \end{matrix}\right\}, \text{ which also do so.}$$

There remain only the two pairs

$$\left.\begin{matrix} IE \\ OA \end{matrix}\right\}, \text{ and } \left.\begin{matrix} IO \\ OI \end{matrix}\right\},$$

of which if the first give no conclusion neither can the second which is contained in it. We have, therefore, only to demonstrate that *IEO* is an invalid syllogism in the second figure.

P. S.—Since reading the above paper I find that the relations of the separate moods and figures to which allusion has been made above were given by Mr. Peirce in a paper read before the American Academy of Arts and Sciences in 1867.

J. R. H.

PETROGRAPHY.

Note on the so-called Quartz Porphyry at Hollins Station, north of Baltimore. By G. H. Williams.

[Abstract of a communication to the Naturalists' Field Club, April 30, 1884].

In his first annual report, 1860, Philip Tyson, then State geologist of Maryland, mentioned an occurrence of quartz porphyry near the Relay Station on the Northern Central Railroad. This rock, which is admirably exposed in the cut just south of the present Hollins Station, does at first sight appear to correspond very well to Tyson's designation. It forms a band some three feet in thickness quite conformable to the bedding of the gneiss. To the unaided eye crystals of red feldspar and quartz appear to be porphyritically imbedded in a homogeneous grayish-green groundmass. Under the microscope, however, the rock is seen to possess an altogether fragmental character. Angular fragments of quartz, orthoclase, and plagioclase of all sizes and shapes are mingled with no regularity of arrangement, and are cemented together by secondary substances consisting mostly of silica, green hornblende needles and epidote. The occurrence of such a fragmental band interstratified with the highly crystalline gneisses, might possibly be accounted for by the supposition that it was originally a sedimentary bed, which had not been sufficiently metamorphosed to make a typical gneiss. To such an hypothesis, however, both the angular shape and the great variety in the size of the fragments is strongly opposed. Water must have sorted as well as rounded them.

It seems much more probable that this was originally a gneissic band, differing so far from the others in its constitution, that when subjected to the enormous pressure which raised the Appalachians, it was simply crushed—reduced to a more or less perfect powder, but held by the surrounding rocks in its position and subsequently re-cemented into a solid mass. The mineral constituents are identical with those of the gneiss, and all show, by their disturbed optical character, the action of great pressure. Moreover, the fragments have changed so little in their position that several lying near together may frequently be seen to have originally belonged to one crystal. Such crushed strata which have not been re-cemented are often met with in regions of great dislocation. Their occurrence in the Alps offered great hindrance to the completion of the St. Gothard tunnel.

RECENT APPOINTMENTS.

Professors and Teachers.

Dr. G. Stanley Hall, late a Lecturer in Harvard University and Williams College, (as well as in Baltimore), has been appointed Professor of Psychology and Pedagogics.

Dr. W. H. Welch, now Professor in the Bellevue Hospital Medical College (N. Y.), has been appointed Professor of Pathology in the medical department of this university. W. T. Councilman, M. D., has been chosen an Associate in Pathology.

Sir William Thomson, LL. D., Professor in the University of Glasgow, has accepted an invitation to deliver a course of lectures on Molecular Dynamics, during the month of October.

E. W. Gosse, Esq., of London, Professor elect of English Literature, in the University of Cambridge, England, has been invited to deliver a course of lectures on English Literature.

Professor Corson, of Cornell University, is also expected to deliver a course of lectures on English Literature.

Mr. A. M. Elliott has been designated Associate Professor of the Romance Languages.

Mr. J. Rendel Harris has been designated Associate Professor of New Testament Greek and Palaeography.

Mr. A. L. Kimball, Ph. D., a graduate of Princeton, has been designated an Associate in Physics, and Mr. C. A. Perkins, Ph. D., a graduate of Williams, an Assistant in Physics.

Mr. W. H. Howell, Ph. D., has been appointed the Chief Assistant in Biology.

Dr. Henry Wood has been transferred, by his own desire, from the chair of English to that of German.

Fellows.

The persons below named have been appointed Fellows for the academic year 1884–85 by the Trustees on the recommendation of the Academic Council.

Ethan A. Andrews, of New York City, Ph. B., Yale College, 1881. *Biology.*

William M. Arnolt, of New Brunswick, N. J., B. D., New Brunswick Theological Seminary, 1882. *Greek.*

Gustav Bissing, of Baltimore, A. B., Johns Hopkins University, 1882. *Mathematics.*

Henry Crew, of Wilmington, O., A. B., Princeton College, 1882. *Physics.*

James R. Duggan, of Macon, Ga., A. B., Mercer University, 1877; M. D., Jefferson Medical College, 1879. *Chemistry.*

Arthur L. Frothingham, Jr., of Rome, Italy, Ph. D., University of Leipsic, 1882. *Shemitic Languages.*

Homer W. Hillyer, of Waupun, Wis., S. B., University of Wisconsin, 1882. *Chemistry.*

Abel H. Huizinga, of Zeeland, Mich., A. B., Hope College, 1880. *Shemitic Languages.*

Frederick S. Lee, of Canton, N. Y., A. B., St. Lawrence University, 1878. *Biology.*

Charles H. Levermore, of New Haven, Conn., A. B., Yale College, 1879. *History.*

Gustav A. Liebig, Jr., of Baltimore, A. B., Johns Hopkins University, 1882. *Physics.*

C. W. Emil Miller, of Baltimore, A. B., Johns Hopkins University, 1882. *Greek.*

Henry F. Nachtrieb, of St. Paul, Minn., S. B., University of Minnesota, 1882. *Biology.*

Henry B. Nixon, of Winfall, N. C., University of North Carolina, 1878. *Mathematics.*

Albert G. Palmer, of Baltimore, A. B., Johns Hopkins University, 1882. *Chemistry.*

Ernest M. Pease, of Boulder, Colorado, A. B., University of Colorado, 1882. *Latin.*

Albert H. Tolman, of Pittsfield, Mass., A. B., Williams College, 1877. *English.*

Woodrow Wilson, of Wilmington, N. C., A. B., Princeton College, 1879. *History.*

LECTURES ON CLASSICAL ARCHÆOLOGY.

During the past academic year special attention has been directed to the subject of Archæology and several lectures presenting the different phases of modern inquiry in that subject have been delivered before the students of this University.

An introductory lecture on "The Influence of Athletic Games on Greek Art," was delivered by Dr. CHARLES WALDSTEIN, Director of the Fitzwilliam Museum in the University of Cambridge. An abstract of this lecture is given on page 62 of *University Circular*, No. 29.

Mr. J. T. Clarke's Course on Assos, etc.

MR. JOSEPH THACHER CLARKE, who has been in charge of the excavations made by the Archæological Institute of America at Assos, Asia Minor, gave four lectures on March 10, 12, 14, and 17.

I. A PLEA FOR PRACTICAL ARCHÆOLOGY.

The first of these, a plea for practical research in this field, emphasized the fact that the great rise of archæology, during the past hundred years, to its present position as one of the sciences of exact determination, is mainly due to the development of its practical side: to investigations directly pursued in the lands ennobled by antique civilization.

The history of classical learning, during the past four centuries, has shown that, without frequent and systematic research among the material remains of earlier life, the real intercourse of modern generations with antiquity steadily declines. The want of archæological investigations during the ages succeeding the first great impulse of the Renaissance, and of that intelligent understanding only to be derived from discoveries thus made, resulted in the general stagnation and pedantic lifelessness of all classic learning which is so characteristic of the seventeenth century. The encouraging beginning of classical research made in the *Quattro-Cento* by Brunelleschi, Bracciolini, Squarcione, and notably by Cyriacus of Ancona, did not meet with encouragement sufficient to insure the position of archæological studies two hundred years later. During the seventeenth and the first half of the eighteenth centuries there was consequently no adequate understanding of the ill-arranged collections of antiquities as indices of former growth. The museums, while accumulating worthless curiosities and bric-à-brac of all kinds, dwindled in character to the discouraging cabinets of varieties which were the idle delight of every small potentate. A superficial knowledge of antique lore, and particularly of Latin versions of Greek mythology, was acquired to lend an ignoble grace to the masquerades of Louis Quatorze, and even as late as the time of Gesner, in the first years of the eighteenth century, these branches of learning were generally held in such low esteem that he,—the learned rector of the Thomas-Schule, Goettingen professor, and president of the academy of sciences,—seriously recommended a study of the classics to the *homines elegantes* of his day: that they might thereby be enabled rightly to comprehend the elaborate displays of fire works then in vogue, and dilate with learned emotions before the complicated and tasteless structures of white-of-egg and tinsel placed by the sugar-bakers upon the tables of the great.

The lamentable fate which befell so many of the Arundel marbles is a striking instance of the lack of general interest in archæological studies during this age: of the 250 inscribed stones which once formed part of that famous collection, only 136 ever reached Oxford, the remainder having entirely disappeared during the few years which elapsed between the acquisition of the antiques and their bequest to the university.

The spirit of the 16th and 17th centuries was foreign to the investigation of antiquity,—the age of Winckelmann did not first discover Pompeii, but was rather first prepared to understand the lessons taught by its ruins, and hence systematically to seek the treasures hidden by its debris.

Yet the wealth and interest of classic lands two hundred years ago may be judged from the fact that one explorer in the Archipelago returned to Europe with originals and copies of more than two thousand inscriptions. Cyriacus, Spon, even Stuart and Revett, saw and described monuments of antiquity which have now entirely disappeared. The Parthenon was practically intact when the earlier travellers visited Athens. The weathering of time, and above all the vandalism of man, steadily continue to deprive us of the material remnants of former civilizations. The rapidity of this destruction must be inconceivable to those not acquainted with the recent history of classic monuments from personal observation.

Let us not idly lament this inevitable destruction, but rather find in it the greatest stimulus to archæological research. The parable of the Sibylline books is brought forcibly to mind. Former investigators neglected points which we now seek with the greatest pains and prize as brilliant discoveries. We feel painfully that an unpublished monument overthrown, a work of art destroyed, is an irreparable loss: let us also bear in mind that future generations,—to whom even less will remain,—may justly hold us responsible for the opportunities we now neglect.

The lecture presented a review of the chief archæological explorations carried out since the pioneer work of Stuart and Revett, and illustrated the gradual growth of those exact methods of investigation which have given to the research of antiquity the certainty of comparative anatomy.

II. TWO LECTURES ON ASSOS.

The investigations carried on by the Archæological Institute of America at Assos, Asia Minor, give as perfect a picture of the life of a quiet provincial Greek capital, as the recent brilliant excavations at Olympia display the character of a great place of Hellenic festal assemblage.

Assos was a small town,—small even for antiquity, when cities were very far from the enormous dimensions of modern capitals. The number of its inhabitants can never have greatly exceeded twelve or fifteen thousand; but its interest and importance can by no means be judged by that of modern towns of equal size. Athens itself, at the time of its greatest extent and power, is known to have had only ten thousand houses, and twenty-one thousand free citizens, and this figure included the entirely separate harbor-cities of Munychia and the Piraeus. To take a more recent example: the imperial city of Augsburg, at the epoch of its chief historical fame, under Maximilian, had only sixteen thousand inhabitants,—was only about the same size as Assos.

The first report represented three months' excavation. There are now the results of two years of hard work to add to it; and these results have been fully proportionate. The first report was restricted, in the description of buildings examined, to the temple and the Greek bridge. To the knowledge of these structures so many additions have now been made, that the present restorations may be considered as perfect. The temple, already better known than any other building discovered in a similarly ruinous condition, appears as valuable an example for the history of Doric architecture as many which are standing to the top of the entablature. Several more of the reliefs carved upon its epistyle, the importance of which to the history of Greek sculpture is now recognized by all scholars, have been found since the publication of the report, and the entire stone ceiling of the building has been recovered. To this have been added many details, including most interesting and curiously suggestive observations concerning antique stone-cutting and laying.

Our knowledge of the geography of the lands has been further enriched by maps, geological as well as topographical. The story of its archæological recovery has been extended, while its political history has received most important additions.

The digging of the second and third years was mostly restricted to the lower town. Much work was done upon the fortifications of Assos, the finest known works of Greek military engineering. The oldest inhabitants settled close around the Acropolis, building rough walls of enormous blocks, not cut by any metallic tools, upon the levels just at the foot of the volcanic crater, and there did much terracing which was cleverly used by the later Greeks. The first outer circle wall was certainly old at the time of the Lydian invasion. Under the favoring influence of the Aeolic colonization, the city flourished greatly, and a new wall became necessary, which second masonry may have somewhat antedated the Persian wars. By reason of the troubles brought on by the Persian occupation of the land, the city decreased in extent, and when, under Lysimachos, its walls were rebuilt, the entire enclosure north of the Acropolis was relinquished. The ramparts, partially overthrown by sieges, were not considered worth repairing, and a connecting wall was built to the Acropolis in their stead. This noble mass of masonry of the fourth century B. C., rising in many places to some

n height, was joined so accurately that the blade of a pen-knife
n now be introduced between the stones. It was this portion of
hich caused Col. Leake to speak of Assos as the finest representa-
reek city in existence. Under the dominion of the Romans the
l city again increased, and finally re-occupied the space north of
lis, new escarps being built in front of the walls, enclosing them
The fortifications of Assos represent the work of more than a
ears, the masonry in some parts, especially towards the eastern
city, closely resembling the ramparts of Constantinople.

ldings of the Agora, or market-place, of Assos are so interesting
nnected that they are superior to those of all other Greek cities;
thstanding the elaborate works of the many writers who have
d and described the market-place of Pompeii, we may even
gora of Assos to be not only more interesting, but more com-
wn, than the forum of that city. The enormous Stoa, or Colon-
hundred and ten meters in length, was built, it may be with
med, by the architect of the Stoa which surrounded the temple of
lias at Pergamon, so recently excavated. It is constructed of the
Acropolis, an andesite much resembling granite; a comparison
e forms given to this material and to the marble mouldings of
is most instructive. Being ceiled with wood, it needed only one
hind every second column of the front. Next to it, and appar-
same date, is the bouleuterion, or building in which the archives
were kept. It is worthy of note, that most of the inscriptions
in the slides of earth beneath this part of the Agora, evidently
n thrown down during the troubles of the city. The building is
allel in character to the only other bouleuterion known—that in
t Olympia; or rather, it is like the inner portion of that struc-
being at Olympia halls on either side of a centre like the edifice

ding which borders the Agora on the south is absolutely unique.
nly instance of a *Greek* bath known, and the only four-storied
n of antiquity ever recovered. Fortunately, we have beeen able
restore it. Its arrangement is extremely curious and interesting.
l of an enormous hall going through two stories, with twenty-six
upon its side; above this entire structure was a colonnade, the
hich was upon the level of the agora. In front of the stoa
rmous basin for the reception of water, covered by stone lintels
ved that it was not visible to persons on the market-place.
n a subterranean conduit to the lower story of the bath, and there
gements for the water to flow into the thirteen lower cells. The
r was led into a larger basin beneath the bath building. There
r reservoir to receive the water from its roof; this connected
reet, and so formed an enormous fountain, giving pure water for
ption of the people, while the water of the refuse basin adjoining
for the cooling of the theatre.

the bath was built, in later times, a small heroön, in which the
he benefactors of the city were deposited, their names being
n the entablature. We opened the three sarcophagi standing in
ng, which were found to contain only strigils, small vases, and
f the dead.

nges of plan observable in the agora are peculiarly interesting. In
there was an inclined plane ascending from a lower street to its
when the heroön was intruded, the passage became so narrow
to be turned and transformed into a stairway. Two fine mosaics
tively early date were found just below the retaining wall of the
ce; the larger of these represented victories carrying votive
owards tripods, with a seller of cupids as centre piece; the
ordered with geometrical figures, enclosing couching griffins,—
arms of Assos. At the east of the agora was the bema, where
stood when addressing a crowd, the level of the place being
l above the market-place and flagged, while the remainder, like all
ts before the Christian era, was unpaved.

ther buildings of the lower town, the theatre is now as well
s any building of its class in Asia Minor. Because of certain
s of the stage, its recovery is particularly valuable for the history
k theatre. The gymnasion, at the west of the town, is equal in
n and interest to the gymnasion of Olympia,—the only one
known. Noticeable also is a great atrium, of late date, but
e preservation of Greek forms far into the Roman period,—the
arch appearing with purely Hellenic details. In the lower town of Assos there were no less than seven Christian churches. The street of tombs is perhaps the most interesting burial-ground of the ancients hitherto investigated. It presents monuments of every period: one, notably, cannot be later than the seventh century B. C., and many are as recent as the eleventh or twelfth Christian centuries. In this necropolis are four great mausoleums, one of which presents a perfect parallel to the tombs of the kings at Jerusalem. We here opened one hundred and twenty-four sarcophagi for the first time, and found many cinerary urns, there having been at Assos a mixed system of inhumation and cremation. In the sarcophagi were discovered great numbers of figurini, small vases and glasses, among them some beautiful specimens of thin transparent glass, and several thousand coins.

An instance of the direct search made for materials bearing upon our knowledge of the development of various phases of ancient art may be seen in the fact, that two of the most interesting links that could be desired for Greek architectural history have been found by the expedition,—a proto-ionic capital, which stands between the ornamental spirals of Mesopotamia and the perfected ionic capitals of the Erechtheion; and a proto-doric shaft with a base, which prove with equal certainty the derivation of that column from an Egyptian shaft like that appearing in the tombs of Beni-Hassan.

The work at Assos labors under only one signal disadvantage: its results must be long awaited by those to whose munificence its execution is due.

III. CYRENE.

The Cyrenaica,—that blunt projecting headland some six hundred miles west of the Nile delta, to-day termed by physical geographers the great plateau of Barca,—was well-known to the earliest navigators of the Mediterranean, the Phoenicians and Carthaginians, both of whom appear to have richly profited by its extraordinary natural advantages. The state there founded by Greek colonists attained to an incomparable productivity and wealth during the most glorious period of Hellenic civilization,—was prized as one of the fairest African provinces by the Ptolemaic dynasties and the later Roman rulers — yet, wonderful to relate, this land was so entirely deserted and forgotten in the Middle Ages that for more than a thousand years its very existence was practically unknown to neighboring Europe.

A country which for twenty centuries had been one of the most flourishing states of the world,—a coast easily reached in forty-eight hours sail from Athens during the favorable northern winds prevalent in the summer season, and but little further removed from Italy,—had literally to be rediscovered during the lifetime of many still among us!

It is true that the bare fact of the existence of Greek and Roman remains in the Cyrenaica had been known some time before, but the accounts of the older travellers are so extremely meagre and unimportant that they merely heighten our wonder at the information given to the world by Beechey and by Pacho in 1827.

The first and the only excavations undertaken upon the site were those made by Captain Smith of the Royal Engineers and Commander Porcher of the British Navy. Their work, carried on with but very few men, was commenced in 1861, and completed in October of the same year. Yet the results of this short and ill-provided campaign were so fortunate that they may be said to occupy an exceptional position among similar undertakings. The volume published by the explorers makes mention of the discovery of no less than one hundred and forty-eight pieces of sculpture: some of these, full figures in a remarkably fine state of preservation, being works of first-rate importance. That the irregular work of a few months, carried on by naval officers untrained in scientific archæological research, should have been attended by such astonishingly favorable results is the greatest possible incentive to the undertaking of thorough investigations upon this once magnificent site.

The possibility of such rich discoveries is explained by the history of the ancient growth and overthrow of the city, and especially by the neglect which has since preserved the antique remains, in an almost deserted province.

Some of the most vexed questions of Archæology are likely to find their solution through investigations in the Cyrenaica. The influence of Egypt upon the early civilization of Greece can nowhere be displayed in greater directness than on this debatable ground. A knowledge of Cyrenian works cannot fail to give an incomparable insight into the development and independent advance of Hellenic forms.

Among all Greek cities there remains not one so accessible to the explorer as Cyrene; yet decisive changes in the government of Tripoli, and the consequent accessibility of the land, are imminent. Let us trust that this last remaining opportunity,—one offering exceptional advantages, may be vigorously followed up by our own country. We can never hope for a more favorable chance to make amends for a long and discreditable inactivity in the field of archæological research.

Mr. W. J. Stillman's Course of Lectures.

Mr. W. J. Stillman, late U. S. Consul at Crete, gave three lectures on March 19, 21, and 24.

I. Prehistoric Research in the Classical Field.

The first lecture was devoted to an account of the prehistoric ruins of Central and Southern Italy and Greece, commonly called Cyclopean or Pelasgic, which the lecturer classified and systematized, showing that the technical characteristics of this class of remains oblige us to connect them with a civilization independent of that of Asia Minor or Egypt, which he concluded to have been indigenous to Italy and to have been Pelasgic. As a parallel demonstration to that of the ruins, the lecturer collated the principal traditions about the Pelasgi, and elaborated the argument in favor of a fourth great independent civilization, those of Egypt, Mesopotamia, and China having been long admitted to be independent of each other. These Pelasgic ruins are of the stone epoch, ranging down to that of elaborately polished stone.

"I think it is impossible to avoid the conclusion that this entire series of constructions belongs to a civilization which had nothing whatever to do with that of the East, of Egypt, or of Mesopotamia, but which, on the contrary, had its origin and development in the circuit which I have traced, where it was the earliest of which we have any indication, and that where any wall occurs in that range containing brick, cut stone, or cement, it must be at once relegated to an epoch at least postheroic; I believe that this cycle closed by the entry into its realm of Eastern arts and knowledge consequent on the great ethnical movement typified possibly, or possibly ended, by the Trojan war. It met in Crete, in Asia Minor, and later in Greece, the Eastern movement, and the methods and knowledge of both are henceforth common property of the classical world.

"The more definite conclusion to which I am forced is that these remains were the work of a civilization which had its origin in Lower or Central Italy, and, moving southwards from a great centre in Etruria, made the seat of its highest power in the mountainous country of the Sabines, the cities about Alatri forming a large congeries of important states, or an empire relatively greater than any subsequent power in Italy until the Roman. The movement of this civilization or empire was down into Apulia, where are numerous remains of this polished stone period to which Alatri, Arpino, and Mykenae belong; then it reappears with unique distinctness at Kaphalu in Sicily, passes over to the Illyrian shores across the narrows of the Adriatic, extends only as far northwards as Dodona and Apollonia, but southwards founds a city or more on every one of the Illyrian Islands—Leukas (of Korkyra we can say nothing, as the Venetians had the habit of destroying all antique remains to construct their fortresses when more convenient than quarrying, and of Zante we know similarly of no remains); Kephallenia four or five; Ithaca two—and all along the main coast, then appearing in great force through the Peloponessus, in Kythera, Anti-Kythera, in Crete especially; and at various points following the northerly receding coast of Attica, and in Thessaly. But while this peculiar construction appears in the vicinity of Smyrna and in the Troad there is no trace of it in Phoenicia, Egypt, or any of the northern coasts of Africa."

II. The State of Research in Greece.

The second lecture, following the development of Hellenic art, showed the relations of the Pelasgic to the later epochs, and indicated the points from which, by the archæological indications, the most important information as to that development was to be hoped for, and followed the chief excavations of the last few years. It pointed out the important relation between the archæology of Athens and that of all the East, and showed the importance, under present political circumstances, which an American school of archæology at Athens might have in the development of that science, considering the mischief which the Greek archæological laws and jealousy of foreign governments had done, and which an American influence free from all political rivalries and animosities might help to remedy.

"The politics of Greece witness an amount of foreign interference which no other country in the world is obliged to submit to. Every diplomatic functionary of every European government considers himself authorized to interfere in the conduct of affairs, bully the ministers, stand between them and the king, dictate and veto as if Greece were really a province of his own country. The Greeks are abused for bad and unstable government when they have not even the shadow of administrative independence. The natural consequence is a refractoriness to foreign influence on the part of the best and most independent minds of the country which extends with a morbid irritability to every interest, even to archæological concessions.

"I believe that an American school properly endowed for real archæological work would be the most potent possible agency in the mollification of the Greek animosity to outsiders, and would be free to operate without any political jealousy, or suspicion of any attempt to acquire undue influence of any kind, and might well, being free from any suspicion of hidden purposes, approach the minds of all intelligent Greeks in a way which should lead to the desirable modification in their laws. To accomplish this would be meriting the laurel crown for our country. Apollo and the Muses invite us to receive their blessing in such a work."

III. The Relations of Art to Archæology.

The third lecture dealt with the relation of art to archæology and the division of art criticism into the archæological or scientific, and the aesthetic or sympathetic. To the former, Morelli's studies on the Italian school were recommended as a model and commencement; the German school of critics are in this branch preëminent, and we owe the proper method to their studies. In the aesthetic department the lecturer did not accept the German method or results, but looked to Burke as the founder of the true school of aesthetics, and Cousin, Ruskin, and the Platonists as following the line of investigation most likely to make aesthetics a scientific study.

He developed the homologies of the various forms of art, painting, music, etc.,—arguing that they all are governed by definite laws, the development of which proves that art is not imitation of nature but the expression of individuality and human emotion, its primary law being that of harmony and not resemblance. This was shown by a study of the growth and decline of the various epochs of art production, which invariably began to deteriorate when portraiture was reached.

Dr. A. Emerson's Lectures on Olympia, etc.

Dr. A. Emerson, Fellow in Greek, gave six lectures on Olympia, March 26–April 7, 1884.

I. The Olympic Festival.

A saying of Ernst Curtius: "The wreath is the armorial bearing of Greece," is borne out in the history of the Hellenic people, which is a continuous race of the Greek cities and tribes for the prize of excellence. In public and private life, the desire and delight of surpassing others is the key-note of the Greek character. Formal contests for a set prize, a preëminently Greek institution, concentrated effort in every department of activity, and thus deeply influenced the physical, intellectual, and moral development of the Greek race. Feasts and funerals were the occasions of athletic games in the heroic age; afterward these became fixed institutions of periodical recurrence. Many such celebrations originated in funeral rites; all were associated with the worship of the gods. Among a hundred, but few attained to a more than local importance; only four, the games celebrated quadrennially at Olympia, Delphoi, Nemea, and the Isthmos, were considered Panhellenic or national. The endeavor to elevate the Panathenaia to the same rank failed. Elsewhere, prizes of value, jars of oil at Athens, a silver cup at Marathon, etc., or even money, could be won; the prize of the national contests was the purely symbolical wreath. Greeks and barbarians recognized the elevating moral effect of so high an appreciation of excellence. The Olympic games were earliest established, greatest in renown, and longest celebrated. Their origin dates from mythic times. Conflicting legends indicate that many Doric and Achaian peoples had a share in their establishment. In the ninth century, Iphitos of Elis established a truce, by which the celebration of the games in time of war became possible, obtained the protection of Doric states for the neutrality of Elis by introducing there the cult of Herakles, and abolished the giving of material prizes, thus laying the foundations of Olympia's greatness. The document of the sacred truce (*ἐκεχειρία*), graven in ancient lettering upon a round stone afterward preserved at Olympia, is the earliest authentic Greek inscription of which we have record, and proves these events historical.

In 776 B. C. the registration of the victors so important for Grecian chronology was begun. The victor in the foot-race, a dash of 600 Olympic feet (192.27 m.), gave his name to the Olympiad. Under the pious pretext, at first, of restoring the practices of the heroic age, other athletic contests, and horse-races, were introduced from time to time, until the wreaths distributed numbered seventeen or more. The fashion and conditions of these contests were explained in detail and illustrated with diagrams from ancient sculptures and paintings. Uniform training, early registration, and fair play were required of the athletes, under penalty of exclusion, or, if fraud was discovered too late, of heavy fines. After the 15th Olympiad, the contestants entered the lists naked. Ancient and modern records were compared:

Day's run: Good Greek record, 150 km.;
Good modern record, 168 km.
Long running jump: Best Greek record, 55 feet;
Best modern record, 49 feet (Engl.) 3 inches.

As the victors in the horse-races were the registered owners of the animals, such victories could be and often were won by women. The course of a celebration in the time of Olympia's greatest prime was then narrated. The sacred month, Apollonios or Parthenios alternately, and with it abstention of all Greek soldiery in all Greek lands from molestation of persons journeying to the games, began with the first or second new moon after the summer solstice and was announced by Eleian heralds. The festival occupied five days from the 11th to the 15th of the month. The spectators found the athletes with their trainers, and the managers of the games, already on the ground. The multitude encamped around the Altis. Girls were permitted to see the games, but married women were excluded from the sanctuary for the five days of the festival, upon pain of death, and took up their abode on the other side of the Alpheios. The first day was devoted to the swearing-in and lot-drawing of the contestants and to public sacrifices. The processions of delegations from the Greek states were the chief feature of interest. The second day witnessed the contests of the boys. The central day decided the victory in the principal contest, the Stadion dash, and in the other foot-races of the men. Beginning at sunrise with the Dolichos, the sports were concluded at evening with the Pankration. On the fourth day the spectators saw the driven and ridden horse-races in the Hippodromos. The splendid spectacle of the four-abreast chariot-race made this day equal the third in interest. In the afternoon, the spectators returned to the Stadion to see the long-drawn-out contest of jumping, quoit and javelin throwing, running and wrestling, which constituted the Pentathlon. The presence, among the throng of spectators, of eminent Greek statesmen, warriors, philosophers, orators, and poets, contributed to the interest of the festival. The last day, when the distribution of the wreaths was over, afforded opportunity for the production of the odes written for the victors by such poets as Pindar or Simonides, and for the orations of a Gorgias and a Lysias. The banquets of the victors, often given at lavish expense, and protracted far into the night, concluded the festival. Still greater display could be made on the return of the victor to his native city. Exainetos of Akragas passed through the breach in its walls escorted by three hundred span of milk-white steeds. Lakedaimonian victors fought nearest the Spartan king in battle. The Olympic wild-olive wreath could not have been held in greater esteem.

II. Topography of the Vicinity of Olympia and History of the Locality to the Completion of the Excavations.

The people of Elis were the installed managers of the national festival, and the land and people on the one hand, the games on the other, mutually influenced each other. The other cantons of the Peloponnesos that gird Arkadia round about, are separated from each other and from the central canton by lofty mountain ranges. Between Arkadia and Elis there is no water-shed; the waters of Arkadian rivers flow from the mountainous interior of the peninsula through the spreading valleys of Elis to the western sea. Some ancient geographers, for this reason, considered the two one. It was the neutrality attendant upon the curatorship of the games that preserved to Elis its early independence. A flat, marshy shore, with poor anchorages, turned the minds of the inhabitants from trade, and the insect pests of the lowlands kept them in the fertile interior hills and valleys, cattle-raising and farming. The Phoinikians and the sailor-folk of the neighboring Ionian islands had the trade to themselves. The Eleians lived, for the most part, on their paternal acres, in profound peace, and satisfied with an oligarchical government. Travelling justices and village fairs made it unnecessary for the country people to frequent the city. Polybius (iv, 73) tells of families none of whose members had for generations left their inherited lands for the city. Cotton was grown here alone in Greece, and woven into costly fabrics. Populous and law-abiding to a remarkable degree, Elis was withal a very religious country, "everywhere full of shrines of Artemis and Aphrodite and the nymphs, in groves abounding in flowers by reason of the moisture, and studded with chapels of Hermes along the roads and little sanctuaries of Poseidon on the coasts" (Strabo, p. 343). With less of prosperity, such is still the character of the region. The course of the Alpheios river and of its tributaries was described. The curious phenomena connected with the lake of Pheneos and the floods produced from time to time by its emptying itself into the Ladon were dwelt upon at length and it was shown that the deposits of earth over the site of Olympia are due to other causes. The five roads by which Olympia was anciently approached were traced on the map.

The history of the games was followed from their prime in the fifth century through the "colonial" fourth century to the decline of their Greek character by the admission of Romans and other barbarians, and through the increasing degradation of the Roman period to the victory of the Armenian Artavazd at the last celebration of the games in the 293d Olympiad, and Theodosius's prohibition of the games, A. D. 394. The Gothic hordes of Alaric invaded the Peloponnesos one year after this Christian prohibition of the pagan festival. They plundered, but did not destroy. In accordance with an edict of Theodosius II.; ordering the destruction of the remaining heathen sanctuaries, the temple of Zeus was fired A. D. 426. The final overthrow of the structure appears to be due to the great earthquake of July 9, A. D. 551, which buried 4000 people under the ruins of Naupaktos. Nothing more is heard of Olympia until modern times, when Montfaucon and Winckelmann were the first to advocate an excavation now happily consummated by the efforts of E. Curtius and the intelligent liberality of the German Diet, which voted $150,000 for the purpose.

III. The Description of Pausanias.

A Greek of the age of Hadrian and the Antonines has left us a description of Olympia in forty-two chapters, written in A. D. 174; these are in the books devoted to Elis of the Description of Greece by Pausanias, of Magnesia by the Sipylos. The writer and his manner were characterized. An antiquarian by predilection, he is very full on the older monuments of the Altis, but cares little for the later works, the most extensive and striking of which, the water-works and exedra of Herodes Atticus, he does not even mention. The most valuable parts of these chapters are those containing the minute descriptions of the ark of Kypselos in the Heraion and the statue of Zeus in the great temple. As making possible a mental reconstruction of this greatest work of Pheidias, the wonder of all antiquity, the latter description is of wider interest, and was entered upon in detail. The technical processes of statuary in gold and ivory were elucidated in accordance with the researches of Quatremère de Quincy, and illustrated by diagrams showing the processes of working ivory, and composing reliefs and statues out of pieces of ivory mechanically reproduced after the parts of a dissected plaster model.

IV. The Chief Architectural Monuments of the Altis.

Pausanias tells of a carefully protected wooden column shown him at Olympia, which tradition took for a part of the house of Oinomaos. In the Heraion he saw a similar monument of the primitive wood architecture of the Hellenes, the authenticity of which is now proved beyond a doubt by the curious features in the architectural remains of the Heraion. 1096 B. C. is the date tradition assigns for the building, and that may be the date of erection of the first temple on this site. It is not possible to assign a date for the temple of which the ruins exist, as it was not built at one time. A very elongated brick cella is surrounded by Doric columns placed so wide apart that a wooden entablature must be inferred—and no fragments of an entablature were discovered. There is no uniformity in the diameter, the fluting, or the capitals of the columns, whence it appears that they were inserted one by one as the older wooden pillars rotted and weakened. The wood derivation of the Doric style is thereby established. The inner portico was an addition not contemplated in the original plan, of which it preserved the alcove arrangement of the side walls, comparable to that of the temple of

Bassai. The terra cotta tiling and roof-decoration, which can be reconstructed from the pieces found, was archaic and elaborate. The building of the temple of Zeus occupied some fifteen years from the 77th to the 80th Olympiad, not, as was formerly supposed, 120 years. The booty made by the Eleians in subjugating a revolt of the Pisatis furnished the means for its erection by Libon, an Eleian architect. It is built of porous limestone, in the best style of Doric art, as a peripteral hexastyle of normal proportions (length, top of stylobate 64, 10 m. = 200 Olympic feet; width 27.72 m; height, inclusive of akroterion, 68 Olympic feet). Of other edifices of Olympia, the Buleuterion, in which the Eleian Council met during the festal month, is the most interesting. It was situated without the Altis, and is a unique example of Greek civic architecture. The ruined state and restorations of these and other buildings, with their details, were shown by means of the stereopticon.

V. THE SCULPTURES OF THE TEMPLE OF ZEUS.

The stereobate, walls, and columns of the temple must have stood completed at the opening of the seventy-ninth Olympiad. By this time the amount of sculptural work to be employed in the decoration of the temple had to be determined, and the execution of it confided to the artists whose services could be secured. Technical and practical considerations forbade the thought of adding the sculpture after the constructive portions of the architecture were in place. It is known that at Phigaleia, not far from Olympia, artists as distinguished as Onatas and Iktinos were hampered by dictation on the part of an ultra-conservative priesthood. At Olympia, where the progress of Greek art had, as it were, its living record, meddling with an artist's design on the part of the Eleian commissioners was not to be expected. But subjects and treatment, if the artists took their task seriously, had to indicate an agonistic sanctuary, with a local story and a Panhellenic significance, dedicated to the supreme Zeus. Nor was this enough, if harmony and artistic unity were not preserved. These last postulates required that all, workmen or artists, who worked at the sculptural decoration should be made subordinate to one head. Pheidias, to whom this position was given at Athens, did not come from Attica to Elis till the 83d Olympiad. Pausanias tells us that Paionios of Mende was the author of the Eastern pediment-group; the less conspicuous Western pediment was filled by Alkamenes. The inscription of Paionios on the base of the great marble Victory executed by him for the Messenians boastfully records that in a formal competition the prize was awarded to his *finials for the temple*: "καὶ τἀκρωτήρια ποιῶν ἐπὶ τὸν ναὸν ἐνίκα." The finials of the temple were the statuettes of Victory that topped the pediments and the cauldrons surmounting the four corners, works of gilded bronze. Regarding these pieces as of small account, compared with the great statuary group of the pediment, eminent German archæologists have translated ἀκρωτήρια by "statues of the pediment," thereby unwarrantably wresting the word from its technical significance. The lecturer saw in this competition and victory a trial of skill, the outcome of which was the placing of the approved master in the position of chief director of all the sculptural work about the temple. It was fitting that this responsibility and honor should be vested in the artist whose design for these very conspicuous, though small, pieces, which were to crown the finished temple, showed the truest feeling for the spirit of the place and the keenest appreciation of architectural effect; fitting that the artist should be proud of what was the beginning and marked the end of his work on the temple. The spirit of the *agon* in formative art breaks out in its best periods. It is known of Alkamenes, on this occasion surpassed by Paionios, that he afterward grew to compete with Pheidias. The best test is not necessarily a design for the intended work itself. Ghiberti's relief of the Sacrifice of Isaac, now seen with Brunelleschi's in the Bargello at Florence, proved him a better man than Brunelleschi or della Quercia to trust with the execution of the great bronze doors of the Florentine Baptistery, a work of fifty years. The lions' heads of the cornice are merely architectural ornament; those preserved show, in a striking manner, the different degrees of ability represented among the commoner workmen. The sculptural decoration conformed to the character of the temple according to an evident system and plan. In the twelve metopae of the cella fronts, so disposed as to meet the eyes of the visitor in their due order, the contests and victories of Herakles, the son of Zeus, were represented, possibly by Paionios' Northern and Eleian assistants. The subject of the Eastern pediment group Paionios took from the local legend of Olympia; Pelops and Oinomaos, with their retinues, were seen preparing for their oft-sung chariot-race. The figure of Zeus, in the centre of the pediment, showed him sharing in and controlling the affairs of men. In the Western pediment, Alkamenes had rendered in marble the combat of the Centaurs and the Lapithai, the favorite subject of the Greek chisel because it celebrated the contest of law and order against ruthless and forbidden forces, the triumph of the athletic Greek over the uncouth monstrosity of the Barbarian. Apollon, the first Olympic victor, stood in the centre, turning the scales of battle in favor of the Greeks. Prayer and thanks for divine favor, in Greek form sacrifice to Zeus, the giver of all victory and success, was the thought embodied in the acroteria. The sculptures themselves, studied from the photographs of the originals and the model restorations by Grüttner, revealed an essential unity of style throughout, due partly, perhaps, to the commanding position of the principal artist, but in even greater measure to the northern Greek nativity of the sculptors. Mende, the birthplace of Paionios, and Lemnos, that of Alkamenes, were both in the pale of the pictorial Thessalo-Thracian school of art which deeply influenced Athens itself through Polygnotos of Thasos. Again, different pieces and parts, both of the metopae and of the pediment statues, display dissimilarities and inconsistencies such as cannot be due to the unequal skill of workmen: Olympia itself was a school and the traces of its influence are to be seen in certain Peloponnesian and Eleian affinities.

VI. FREE SCULPTURE; THE VICTORY OF PAIONIOS AND THE HERMES OF PRAXITELES.

Delving in the deeper strata of the Olympic soil brought many interesting relics of early art to light; among them are several specimens of primitive bronze work. A griffin's head, anciently the handle of a cauldron, and the beaten plate with a large relief of the winged Artemis holding two lions and a smaller one of Herakles pursuing a Centaur with human fore-legs, show early Greek figured bronzes to have been as Oriental in character as primitive bronze or terra-cotta ornament. The latter piece is of particular interest from the coincidence of the subjects with two that were carved upon the famous chest of Kypselos of Corinth, anciently preserved in the Heraion.

Two stone heads of Hera, the larger one probably that of the temple-image, compared with a small bronze Zeus of very archaic type, show a great superiority of early work in bronze over contemporary sculpture.

The monument erected by the Messenians of Naupaktos to commemorate victories of which the tithe of the booty covered the expense of the erection, a colossal marble Victory on a high triangular pedestal, was executed by Paionios. Even in antiquity there was divergence of opinion as to the event thus commemorated. The taking of Oiniadai by the Messenians of Naupaktos in the 81st Olympiad was a more signal exploit than the participation of Messenian soldiery in the capture of Sphakteria or the harrying of Lakonia after the battle of Pylos. On both occasions plentiful booty was doubtless made. It is probable that the offering was promised to Olympian Zeus in the elation of the successes in Akarnania, but the execution delayed with subsequent reverses until the completion coincided with other victories. The booty coming from different enemies is sufficient reason for the indefiniteness of *δεκάταν ἀπὸ τῶν πολεμίων*. The statue itself reveals astounding progress on the part of its master, without its appearing whether this may be in part due to the influence of Pheidias. The pediment sculptor is recognized in the accommodation of the figure, i[illegible] position and proportions, for its place on a pedestal over six meters high. The pictorial sculptor betrays himself in the bold conception of a floatin[illegible] figure, and in the use of color and light and shade effects in the draper[illegible] which has some peculiarities in common with that on some of the pedime[illegible] figures. If the order for the statue was due to the success of the sma[illegible] bronze Victory for the pinnacle of the temple, it is a fair conjecture that t[illegible] larger statue was an elaboration of the smaller design; the evident copyi[illegible] of Paionios in the acroterion Victories from Delos would thus have natural explanation. We are again reminded of Ghiberti, introducing in [illegible] second door, in freer and larger composition, the subject of his trial-pie[illegible]

The Hermes holding the infant Dionysos, found lying before its ancie[illegible]nt pedestal in the Heraion, is a work of Praxiteles' youth, the time when t[illegible]he renewed prosperity of Arkadia, brought about by Epaminondas, g[illegible]ve employment to several Attic artists, among whom Kephisodotos, Praxite[illegible]s' father, occupied a prominent place.

sixty feet in height, was joined so accurately that the blade of a pen-knife cannot even now be introduced between the stones. It was this portion of the wall which caused Col. Leake to speak of Assos as the finest representative of a Greek city in existence. Under the dominion of the Romans the commercial city again increased, and finally re-occupied the space north of the Acropolis, new escarps being built in front of the walls, enclosing them entirely. The fortifications of Assos represent the work of more than a thousand years, the masonry in some parts, especially towards the eastern side of the city, closely resembling the ramparts of Constantinople.

The buildings of the Agora, or market-place, of Assos are so interesting and well-connected that they are superior to those of all other Greek cities; and, notwithstanding the elaborate works of the many writers who have investigated and described the market-place of Pompeii, we may even assert the Agora of Assos to be not only more interesting, but more completely known, than the forum of that city. The enormous Stoa, or Colonnade, one hundred and ten meters in length, was built, it may be with reason assumed, by the architect of the Stoa which surrounded the temple of Athena Polias at Pergamon, so recently excavated. It is constructed of the stone of the Acropolis, an andesite much resembling granite; a comparison between the forms given to this material and to the marble mouldings of Pergamon is most instructive. Being ceiled with wood, it needed only one support behind every second column of the front. Next to it, and apparently of the same date, is the bouleuterion, or building in which the archives of the city were kept. It is worthy of note, that most of the inscriptions found were in the slides of earth beneath this part of the Agora, evidently having been thrown down during the troubles of the city. The building is exactly parallel in character to the only other bouleuterion known—that in the Altis at Olympia; or rather, it is like the inner portion of that structure, there being at Olympia halls on either side of a centre like the edifice at Assos.

The building which borders the Agora on the south is absolutely unique. It is the only instance of a *Greek* bath known, and the only four-storied construction of antiquity ever recovered. Fortunately, we have beeen able perfectly to restore it. Its arrangement is extremely curious and interesting. It consisted of an enormous hall going through two stories, with twenty-six chambers upon its side; above this entire structure was a colonnade, the floor of which was upon the level of the agora. In front of the stoa was an enormous basin for the reception of water, covered by stone lintels and so paved that it was not visible to persons on the market-place. From it ran a subterranean conduit to the lower story of the bath, and there were arrangements for the water to flow into the thirteen lower cells. The refuse water was led into a larger basin beneath the bath building. There was another reservoir to receive the water from its roof; this connected with the street, and so formed an enormous fountain, giving pure water for the consumption of the people, while the water of the refuse basin adjoining it was used for the cooling of the theatre.

Next to the bath was built, in later times, a small heroön, in which the bodies of the benefactors of the city were deposited, their names being inscribed on the entablature. We opened the three sarcophagi standing in this building, which were found to contain only strigils, small vases, and the bones of the dead.

The changes of plan observable in the agora are peculiarly interesting. In early times there was an inclined plane ascending from a lower street to its level; but, when the heroön was intruded, the passage became so narrow that it had to be turned and transformed into a stairway. Two fine mosaics of comparatively early date were found just below the retaining wall of the market-place; the larger of these represented victories carrying votive offerings towards tripods, with a seller of cupids as centre piece; the other was bordered with geometrical figures, enclosing couching griffins,—the coat of arms of Assos. At the east of the agora was the bema, where the orator stood when addressing a crowd, the level of the place being there raised above the market-place and flagged, while the remainder, like all Greek streets before the Christian era, was unpaved.

Of the other buildings of the lower town, the theatre is now as well recovered as any building of its class in Asia Minor. Because of certain peculiarities of the stage, its recovery is particularly valuable for the history of the Greek theatre. The gymnasion, at the west of the town, is equal in preservation and interest to the gymnasion of Olympia,—the only one previously known. Noticeable also is a great atrium, of late date, but showing the preservation of Greek forms far into the Roman period,—the arch appearing with purely Hellenic details. In the lower town of Assos there were no less than seven Christian churches. The street of tombs is perhaps the most interesting burial-ground of the ancients hitherto investigated. It presents monuments of every period: one, notably, cannot be later than the seventh century B. C., and many are as recent as the eleventh or twelfth Christian centuries. In this necropolis are four great mausoleums, one of which presents a perfect parallel to the tombs of the kings at Jerusalem. We here opened one hundred and twenty-four sarcophagi for the first time, and found many cinerary urns, there having been at Assos a mixed system of inhumation and cremation. In the sarcophagi were discovered great numbers of figurini, small vases and glasses, among them some beautiful specimens of thin transparent glass, and several thousand coins.

An instance of the direct search made for materials bearing upon our knowledge of the development of various phases of ancient art may be seen in the fact, that two of the most interesting links that could be desired for Greek architectural history have been found by the expedition,—a proto-ionic capital, which stands between the ornamental spirals of Mesopotamia and the perfected ionic capitals of the Erechtheion; and a proto-doric shaft with a base, which prove with equal certainty the derivation of that column from an Egyptian shaft like that appearing in the tombs of Beni-Hassan.

The work at Assos labors under only one signal disadvantage: its results must be long awaited by those to whose munificence its execution is due.

III. CYRENE.

The Cyrenaica,—that blunt projecting headland some six hundred miles west of the Nile delta, to-day termed by physical geographers the great plateau of Barca,—was well-known to the earliest navigators of the Mediterranean, the Phoenicians and Carthaginians, both of whom appear to have richly profited by its extraordinary natural advantages. The state there founded by Greek colonists attained to an incomparable productivity and wealth during the most glorious period of Hellenic civilization,—was prized as one of the fairest African provinces by the Ptolemaic dynasties and the later Roman rulers — yet, wonderful to relate, this land was so entirely deserted and forgotten in the Middle Ages that for more than a thousand years its very existence was practically unknown to neighboring Europe.

A country which for twenty centuries had been one of the most flourishing states of the world,—a coast easily reached in forty-eight hours sail from Athens during the favorable northern winds prevalent in the summer season, and but little further removed from Italy,—had literally to be rediscovered during the lifetime of many still among us!

It is true that the bare fact of the existence of Greek and Roman remains in the Cyrenaica had been known some time before, but the accounts of the older travellers are so extremely meagre and unimportant that they merely heighten our wonder at the information given to the world by Beechey and by Pacho in 1827.

The first and the only excavations undertaken upon the site were those made by Captain Smith of the Royal Engineers and Commander Porcher of the British Navy. Their work, carried on with but very few men, was commenced in 1861, and completed in October of the same year. Yet the results of this short and ill-provided campaign were so fortunate that they may be said to occupy an exceptional position among similar undertakings. The volume published by the explorers makes mention of the discovery of no less than one hundred and forty-eight pieces of sculpture: some of these, full figures in a remarkably fine state of preservation, being works of first-rate importance. That the irregular work of a few months, carried on by naval officers untrained in scientific archæological research, should have been attended by such astonishingly favorable results is the greatest possible incentive to the undertaking of thorough investigations upon this once magnificent site.

The possibility of such rich discoveries is explained by the history of the ancient growth and overthrow of the city, and especially by the neglect which has since preserved the antique remains, in an almost deserted province.

Some of the most vexed questions of Archæology are likely to find their solution through investigations in the Cyrenaica. The influence of Egypt upon the early civilization of Greece can nowhere be displayed in greater directness than on this debatable ground. A knowledge of Cyrenian works cannot fail to give an incomparable insight into the development and independent advance of Hellenic forms.

Mathematical Society.

April 23.—Dr. Story in the chair. Nine persons present.

Papers read:
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Before the Romanesque period (XI and XII centuries) there had flourished since the Christian era four styles of Architecture: the Roman, the Eastern (especially Syrian), the Byzantine, and the Lombard: and from a combination of various elements existing in these styles Romanesque Architecture was formed. Its general characteristics are grandeur, simplicity, and power, while during the two centuries when it held sway not only did each country have a distinct form of the style, as France, Germany, Italy, England, and Spain, but every one of these still ununited countries included schools possessing traditions and methods of their own, and developing independently of each other. Some reached a higher scientific development than others, and obtained better results in their endeavors to solve the main architectural problems of the age—the problems connected with the arch and the vault. So that, while by some schools (especially those of Auvergne, Poitou and Perigord in France) completely vaulted churches were built as early as the middle of the XI century, most of the schools lagged far behind and used wooden roofs until the middle of the XII century.

Second. March 8, on Gothic Architecture. (12 present).

A sharp distinction must be drawn between the Transition-style, which formed the link between the Romanesque and the Gothic, and the Pointed style which, although using the pointed arch, had none of the constructional peculiarities of the Gothic. Amidst many conflicting claims it seems certain that Gothic architecture arose (c. 1200) in Northern France and more particularly in the province of the Ile-de-France, where we also find (c. 1150) the style of transition Nowhere are the attributes of true Gothic so well exemplified as in the great cathedrals of Rheims, Amiens, Chartres, and Bourges. From thence the Gothic style spread to other countries: although France, England, Germany, Italy, and Spain had different forms, these were mainly *national*, and there did not exist nearly so many distinct schools as in the Romanesque period. In the XIV century Gothic lost its originality and artistic feeling; it lived on the past; and in the XV century it was overrun with purposeless ornamentation and its forms became perverted and debased, losing the lightness, symmetry, and beauty which characterized its early period.

Third. March 22, on Italian Sculpture during the XIII-XV Centuries. (10 present).

The revival of Italian Sculpture is all the more remarkable that previous to Niccola Pisano it was sunk so low as to seem incapable of renewed life. Niccola's style was not adopted by the school he founded; his massive, powerful figures, full of a quiet majesty, were exchanged for slender, artificial forms, and while the influence of the antique may be traced in him, it is entirely wanting in his successors.

Giovanni his son came under the influence of foreign Gothic art, and the same may be said of the rest of the school. Andrea Pisano, however, and the great unknown sculptors of the Orvieto Cathedral seem to return to an earlier and simpler style, related to Giottesque painting.

The second great phase, beginning with the first years of the XV century shows us the great names of Jacopo della Quercia, Lorenzo Ghiberti, and Donatello. The pictorial style introduced by Ghiberti was fortunately counteracted by the more powerful genius of Donatello aided by the correct artistic taste of the time. It was Donatello who formed most of the sculptors who then acquired renown; but none reached to his height. The cause of his influence was not only that he conceived most completely the naturalistic type of his time, but that he commenced the renaissance of the classical ideal. On the other hand, Luca della Robbia was essentially a religious sculptor and founded an extensive Robbia school. He revived the earlier religious art with greater sentiment and beauty of form, and took, in sculpture, the position corresponding to that of Fra Angelico in painting.

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The XIII century was in Italy the period of the greatest degradation in painting, when exaggeration of expression and distortion of form reached their climax. Giunta of Pisa, Guido of Siena, the Berlinghieri of Lucca and Margharitone of Arezzo do not rise much above the general standard. The revival in Tuscany,—headed in Florence by Cimabue and in Siena by Duccio,—was a regenerated form of Byzantine art: but a new departure, more humanistic and naturalistic in every way, and which spread rapidly in all directions, was taken by Giotto, to whom Simone Memmi corresponds in the Siennese school. During the XIV century these two Tuscan schools reigned supreme, and the few painters who flourish in other provinces acknowledge the rule of their style. Of the rivals, the Florentine adopts a relatively intellectual, and the Siennese a sentimental ideal. After Taddeo Gaddi, Giotto's great pupil, the Giottesque style became rapidly debased, and the Florentine School does not produce any great painter besides Andrea Orcagna, who was a universal master *sui generis*. In Siena the most important successors of Simone Memmi were the two Lorenzetti: there, also, at the close of the century a retrogressive movement takes place.

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The XV century witnesses a great revolution in the Florentine school and its dependencies; while the school of Siena continues to represent the ideal of the XIV. This revolution in Art was caused by human nature being taken as its ideal and its model: hence the uniformity of the preceding period was replaced by distinct and new species developing side by side and which we may call the religious, the naturalistic, the realistic, and the classical.

The ideal and religious style not according with the spirit of the age lost much of its life; but it was reborn in Fra Angelico whose paintings seem inspired and in Fra Filippo Lippi who is inferior only to him; while at the close of the century the school is represented by such great painters as Perugino and Pinturicchio.

Masaccio was the prophet of the naturalistic and psychological school which was completed in Sandro Botticelli, Domenico Ghirlandaio and Filippino Lippi who develop portraiture in religious subjects to its limits. Another form is exemplified by Giovanni Bellini in whom the great power of color appears.

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April 30.—Dr. G. H. Williams in the chair. Eleven members present.

MR. LUGGER reported the discovery of Hornia minutipennis.

This beetle belongs to the large family of Meloidæ, and is parasitic in the nests of the common mason bee. The insect was described and its life history given. Its development is very peculiar, passing through the following stages; egg, first larval stage or triungulin, second larval stage, comprising the carabæid and scarabæid forms, third larval stage, semi-pupa, followed again by a form looking like the third larval stage, true pupa and imago. Mr. Lugger also gave an account of the development of Cænia dimidiata Fab., which he has succeeded in raising to maturity from the larva. The larva looks like the cast-off skin of the common oniscus. The transformation from the larva to the pupa takes place within the larval skin, the latter splitting open along the sides. The pupa is at first snow-white, as is also the imago, the latter soon changes to a sky blue and then to a black with orange colored elytra.

DR. BARTON of the botanical section made a report of the field work during the past month, and stated that several interesting additions had been made to the collection.

DR. WILLIAMS of the geological section made a communication on "The so-called Quartz-porphyry at Hollins station, N. C. R. R., north of Baltimore." (*See p.* 132 *of this Circular*).

May 25.—Dr. G. H. Williams in the chair. Ten members present.

MR. LUGGER gave an account of a strange hymenopterous parasite infesting the larva of Tiphia.

The Tiphia lays its eggs in the so-called white grub, or the larva of Lachnosterna fusca; the larva of the Tiphia when nearly mature eats the white grub and then spins for itself a beautiful silken cocoon. This larva in turn is often infested by the larva of the Rhipiphorus pectinatus or R. limbatus, the eggs of which have become fastened to the Tiphia, and in this way reach the Tiphia cocoon—as stated Mr. Lugger has also found in the same cocoons small hymenopterous parasites. The order of events in this case appears to be that the larva of a large coleopterous insect is destroyed by a hymenopterous larva, this in turn by a coleopterous larva, and this again by a hymenopterous larva.

DR. STERNBERG made an address on micrococci, with especial reference to the micrococcus of pneumonia, which has lately been described.

MR. DONALDSON showed two specimens of Liparis liliifolia found at Texas, N. C. R. R., Md., which possessed the keeled leaves characteristic of L. lœsellia. He also mentioned a fertile plant of Podophyllum peltatum with only one leaf, and a sterile specimen with the stem continued into a leaf-like structure.

MEETINGS OF ART CIRCLES.

Under the auspices of the University Archæological Society, DR. A. L. FROTHINGHAM, JR., has organized several circles for the study of various phases of art, illustrated by photographs and engravings. The meetings have been held in the rooms of the Peabody Institute and the following subjects have been taken up.

First. March 1, on Romanesque Architecture. (16 present).

Before the Romanesque period (XI and XII centuries) there had flourished since the Christian era four styles of Architecture: the Roman, the Eastern (especially Syrian), the Byzantine, and the Lombard: and from a combination of various elements existing in these styles Romanesque Architecture was formed. Its general characteristics are grandeur, simplicity, and power, while during the two centuries when it held sway not only did each country have a distinct form of the style, as France, Germany, Italy, England, and Spain, but every one of these still ununited countries included schools possessing traditions and methods of their own, and developing independently of each other. Some reached a higher scientific development than others, and obtained better results in their endeavors to solve the main architectural problems of the age—the problems connected with the arch and the vault. So that, while by some schools (especially those of Auvergne, Poitou and Perigord in France) completely vaulted churches were built as early as the middle of the XI century, most of the schools lagged far behind and used wooden roofs until the middle of the XII century.

Second. March 8, on Gothic Architecture. (12 present).

A sharp distinction must be drawn between the Transition-style, which formed the link between the Romanesque and the Gothic, and the Pointed style which, although using the pointed arch, had none of the constructional peculiarities of the Gothic. Amidst many conflicting claims it seems certain that Gothic architecture arose (c. 1200) in Northern France and more particularly in the province of the Ile-de-France, where we also find (c. 1150) the style of transition. Nowhere are the attributes of true Gothic so well exemplified as in the great cathedrals of Rheims, Amiens, Chartres, and Bourges. From thence the Gothic style spread to other countries: although France, England, Germany, Italy, and Spain had different forms, these were mainly *national*, and there did not exist nearly so many distinct schools as in the Romanesque period. In the XIV century Gothic lost its originality and artistic feeling; it lived on the past; and in the XV century it was overrun with purposeless ornamentation and its forms became perverted and debased, losing the lightness, symmetry, and beauty which characterized its early period.

Third. March 22, on Italian Sculpture during the XIII–XV Centuries. (10 present).

The revival of Italian Sculpture is all the more remarkable that previous to Niccola Pisano it was sunk so low as to seem incapable of renewed life. Niccola's style was not adopted by the school he founded; his massive, powerful figures, full of a quiet majesty, were exchanged for slender, artificial forms, and while the influence of the antique may be traced in him, it is entirely wanting in his successors.

Giovanni his son came under the influence of foreign Gothic art, and the same may be said of the rest of the school. Andrea Pisano, however, and the great unknown sculptors of the Orvieto Cathedral seem to return to an earlier and simpler style, related to Giottesque painting.

The second great phase, beginning with the first years of the XV century shows us the great names of Jacopo della Quercia, Lorenzo Ghiberti, and Donatello. The pictorial style introduced by Ghiberti was fortunately counteracted by the more powerful genius of Donatello aided by the correct artistic taste of the time. It was Donatello who formed most of the sculptors who then acquired renown; but none reached to his height. The cause of his influence was not only that he conceived most completely the naturalistic type of his time, but that he commenced the renaissance of the classical ideal. On the other hand, Luca della Robbia was essentially a religious sculptor and founded an extensive Robbia school. He revived the earlier religious art with greater sentiment and beauty of form, and took, in sculpture, the position corresponding to that of Fra Angelico in painting.

Fourth. March 29, on Italian Painting during the XIV Century. (13 present).

The XIII century was in Italy the period of the greatest degradation in painting, when exaggeration of expression and distortion of form reached their climax. Giunta of Pisa, Guido of Siena, the Berlinghièri of Lucca and Margharitone of Arezzo do not rise much above the general standard. The revival in Tuscany,—headed in Florence by Cimabue and in Siena by Duccio,—was a regenerated form of Byzantine art: but a new departure, more humanistic and naturalistic in every way, and which spread rapidly in all directions, was taken by Giotto, to whom Simone Memmi corresponds in the Siennese school. During the XIV century these two Tuscan schools reigned supreme, and the few painters who flourish in other provinces acknowledge the rule of their style. Of the rivals, the Florentine adopts a relatively intellectual, and the Siennese a sentimental ideal. After Taddeo Gaddi, Giotto's great pupil, the Giottesque style became rapidly debased, and the Florentine School does not produce any great painter besides Andrea Orcagna, who was a universal master *sui generis*. In Siena the most important successors of Simone Memmi were the two Lorenzetti: there, also, at the close of the century a retrogressive movement takes place.

Fifth. April 5, on Italian Painting during the XV Century. (15 present).

The XV century witnesses a great revolution in the Florentine school and its dependencies; while the school of Siena continues to represent the ideal of the XIV. This revolution in Art was caused by human nature being taken as its ideal and its model: hence the uniformity of the preceding period was replaced by distinct and new species developing side by side and which we may call the religious, the naturalistic, the realistic, and the classical.

The ideal and religious style not according with the spirit of the age lost much of its life; but it was reborn in Fra Angelico whose paintings seem inspired and in Fra Filippo Lippi who is inferior only to him; while at the close of the century the school is represented by such great painters as Perugino and Pinturicchio.

Masaccio was the prophet of the naturalistic and psychological school which was completed in Sandro Botticelli, Domenico Ghirlandaio and Filippino Lippi who develop portraiture in religious subjects to its limits. Another form is exemplified by Giovanni Bellini in whom the great power of color appears.

The realistic and scientific school headed by Andrea del Castagno and Piero della Francesca studied the human body with a realism repugnant to true art. The Pollajuoli carried this to its extreme limits: Andrea del Verocchio somewhat refined it. The classical renaissance was not so striking in painting as in sculpture: it however inspired many works of Sandro Botticelli, Andrea Mantegna, and Luca Signorelli. Mantegna and Signorelli were the giants of the century, men of comprehensive genius whose influence was lasting: the latter was hardly surpassed by Michel Angelo in mastery over the human figure.

Sixth. May 3, on Ivory Carving from the IV to the XV century. (6 present).

Art history is often best illustrated by its smallest productions: this is emphatically the case with carvings in ivory; not being of a precious material they have been preserved in great numbers and in uninterrupted sequence. The consular diptychs of the IV-VI centuries form an important series: they generally figured the consul presiding over the games. Many articles of ecclesiastical use were carved in ivory, such as church diptychs, pyxes, holy-water vessels, vases, caskets, book covers, and later, *flabella*, *aspersoria*, devotional tablets, triptychs, &c. All these works were carved with the subjects of Christian art.

After the classical and Byzantine period a new style came up with the Carlovingian revival: this was succeeded by a degradation, with some improvement during the Romanesque period. At this time this branch of art was reaching great perfection in the Eastern Empire. When the Gothic style arose there was a great renaissance in ivory carving which became very popular: in France especially it was impressed with all the delicacy and refinement of Gothic sculpture, and many prominent artists devoted themselves to this branch. In Italy, Venice became famous for this specialty and exported carved ivories largely to other countries, while Germany, Spain, and England all possessed national schools.

The ARCHÆOLOGICAL INSTITUTE OF AMERICA founded five years ago for the promotion of archæological research and discovery on classical and American soil, by action of its Council in Boston May 17, 1884, urged the formation of affiliated societies in other cities. These societies, besides sharing in the general advantages of the Institute, may, by electing members into the General Council, influence the work undertaken by the Institute, and create local interests by meetings, publications, etc.

The University Archæological Society appointed Drs. Emerson and Frothingham a committee to forward the formation of a Baltimore Society by the addition of other members. The old and new members of the Institute were invited to meet on June 5th, at 8 p. m., in President Gilman's office for the formal organization of the Society. Mr. John W. McCoy, whose interest in art and archæology is well-known, was chosen President. Dr. Emerson and Dr. Frothingham were named respectively recording and corresponding secretaries. The Baltimore Society at present numbers twenty-three members, as follows: Charles J. Bonaparte, George W. Brown, Arthur M. Elliott, Alfred Emerson, Arthur L. Frothingham, Jr., Miss Mary Garrett, Robert Garrett, T. Harrison Garrett, Basil L. Gildersleeve, Daniel C. Gilman, Edward M. Greenway, Jr., Joshua G. Harvey, Reverdy Johnson, Miss E. T. King, John W. McCoy, N. H. Morison, Charles D. Morris, Edmund Law Rogers, William W. Spence, S. Teackle Wallis, Harry Walters, Minton Warren, Miles White, Jr.

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JOHNS HOPKINS

UNIVERSITY CIRCULARS

BALTIMORE

1884—1885

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CALENDAR, 1884–85.

Tuesday, September 23.	**Current Academic Year Began.**
Tuesday, September 23—Saturday, September 27.	**Examinations for Matriculation.**
Tuesday, September 30.	**Instructions Resumed.**
Wednesday, December 24—Saturday, January 3.	**Christmas Recess.**
Monday, February 23.	**Commemoration Day.**
Friday, June 12.	**Term of Instruction Closes.**

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STANDING ANNOUNCEMENTS.

JOHNS HOPKINS UNIVERSITY.

Opened for Instruction in 1876.

The Johns Hopkins University was founded by the munificence of a citizen of Baltimore, Johns Hopkins, who bequeathed the most of his large estate for the establishment of a University and a Hospital. It was intended that these institutions should coöperate in the promotion of medical education. The Hospital buildings are approaching completion.

The foundation of the University is a capital, in land and stocks, estimated in value at more than $3,000,000; the capital of the Hospital is not less in amount.

The University was incorporated under the laws of the State of Maryland, August 24, 1867. Power to confer degrees was granted by the Legislature in 1876.

Suitable buildings have been provided in Baltimore at the corner of Howard and Little Ross Sts., and are furnished with the necessary apparatus and books.

ACADEMIC STAFF, 1884-5.

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OTTO LUGGER, *Curator of the Biological Museum.*

PLAN OF THE CIRCULARS.

The Johns Hopkins University Circulars are published at convenient intervals during the academic year for the purpose of communicating intelligence to the various members of the University in respect to work which is here in progress, as well as for the purpose of promulgating official announcements from the governing and teaching bodies. During the current academic year, successive circulars may be expected in the months of November, December, January, March, April, May, and June, to be followed at the close of the year by an index.

Although these circulars are designed for the members of the University, they have frequently been called for by institutions and libraries at a distance, and also by individuals who are interested in the literary and scientific activity of this University. Subscriptions and exchanges are therefore received.

TERMS OF SUBSCRIPTION.

For the current year, 1884-5, $1.

For the year 1883-4, (140 pp. in cloth covers), $1.50.

For the year 1882-3, (156 pp. in cloth covers), $3.

For the years 1880-2, (250 pp. in cloth covers), $5.

Subscribers to the Circulars will also receive the Annual Register and Report of the University.

All subscriptions should be addressed to the "Publication Agency of the Johns Hopkins University."

Communications for the Circulars should be sent in prior to the first day of the month in which they are expected to appear.

HOPKINS HALL LECTURES.

Notice in Respect to the Admission of the Public.

In answer to inquiries, and in correction of some current misapprehensions, the following statements are made in respect to these courses of lectures annually given in the Johns Hopkins University.

1. These courses are academic lectures, designed primarily for the members of the University, and supplementary to the regular class-room work of the students.

2. As the members of the University rarely require the entire room, the Trustees have taken great pleasure in inviting other persons, not connected with the University, to attend.

3. As these lectures are not intended for popular entertainment, but for the instruction of students, those persons first receive tickets, in most cases, who are known to be especially interested in a particular course,—ladies as well as gentlemen. Preference is thus given according to the character of the course, to teachers in other institutions, public and private; students of medicine, law, etc.; professional men and others. If any tickets remain undistributed, they are given out to those who may have applied for them, in order of application.

4. The hall is full when 200 hearers are present; it is uncomfortable if more are admitted. Not infrequently two or three times that number of persons apply for admission, and often applications for tickets cannot be granted. To give the lectures elsewhere would alter their character as a part of the ordinary academic work of the University.

5. *There is no general course ticket issued.* Applications should state specifically the course for which tickets are desired. Programmes and other current information pertinent to university work may be found in the *University Circulars*, sent to subscribers on the payment of one dollar per annum, either by Messrs. Cushings & Bailey, Messrs. John Murphy & Co., or the University.

The usage of giving personal notification is not likely to be continued, and those therefore who have been accustomed to receiving such announcements, should hereafter consult the *Circulars*.

6. It will save much delay if applications for tickets and inquiries on these and other routine matters are addressed not to individuals but to the JOHNS HOPKINS UNIVERSITY, *by postal card*, and answers will be promptly returned by mail. Personal applications consume time needlessly.

☞The lectures begin at 5 o'clock *punctually*. The doors of the hall are opened at fifteen minutes before 5, and the lectures do not exceed an hour in the delivery.

PUBLICATIONS ISSUED UNDER THE AUSPICES OF THE UNIVERSITY.

I. American Journal of Mathematics.

The publication of this journal commenced in 1878, under the editorial direction of Professor Sylvester, and is now conducted by Professor Simon Newcomb as Editor, and Dr. T. Craig as Associate Editor. Six volumes of about 400 pages each have been issued, and the seventh is in progress. It appears quarterly, in the quarto form. Subscription $5 per year. Single numbers $1.50.

II. American Chemical Journal.

This journal was commenced in 1879, with Professor Remsen as editor. Five volumes of about 450 pages each have been issued, and the sixth is in progress. It appears bi-monthly. Subscription $3 per year. Single numbers 50 cts.

III. American Journal of Philology.

The publication of this journal commenced in 1880, under the editorial direction of Professor Gildersleeve. Four volumes of about 570 pages each have been issued, and the fifth is in progress. It appears four times yearly. Subscription $3 per volume. Single numbers $1.00.

IV. Studies from the Biological Laboratory.

[*Including the Chesapeake Zoological Laboratory.*]

The publication of these papers commenced in 1879, under the direction of Professor Martin, with the assistance of Dr. W. K. Brooks. Two volumes of about 500 pages, octavo, and 40 plates each, have been issued, and the third is in progress.

V. Studies in Historical and Political Science.

The publication of these papers was begun in 1882, under the editorial direction of Dr. H. B. Adams. The first volume of 470 pages is now completed, and the second is in progress. Subscription $3 per volume.

The following publications are also issued by the University:

The UNIVERSITY CIRCULARS. Subscription $1 per year.

The ANNUAL REPORT presented by the President to the Board of Trustees reviewing the operations of the University during the past academic year.

The ANNUAL REGISTER giving the list of officers and students and stating the regulations of the University. Published at the close of the academic year.

The University Circulars, Annual Report, and Annual Register will be sent by mail for one dollar per annum.

All communications in respect to these publications should be addressed to the "Publication Agency of the Johns Hopkins University," Baltimore, Maryland.

In addition to the serials above named, a few copies are for sale of the papers named below:

STUDIES IN LOGIC. By members of the Johns Hopkins University. C. S. Peirce, Editor. (Boston: Little, Brown & Co.) 1883. 123 pp., 12o. $2.

THE DEVELOPMENT AND PROPAGATION OF THE OYSTER IN MARYLAND. By W. K. Brooks. 1884. 193 pp., 4o. 13 plates and 3 maps. $5.

ON THE MECHANICAL EQUIVALENT OF HEAT. By H. A. Rowland. 1880. 127 pp., 8o. $1.50.

NEW TESTAMENT AUTOGRAPHS. By J. Rendel Harris. 1882. 54 pp., 8o. 4 plates. 50 cents.

ENUMERATION OF CLASSES, FIRST HALF-YEAR, 1884-85.

Mathematics. (73 Students).

Classes meet in Rooms 8, 14, and 16.

Analytical and Celestial Mechanics: PROFESSOR NEWCOMB. Twice weekly, Tuesday and Thursday, 9 a. m. (11).

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Duncan.
Fields.
Franklin.
Mansfield.
Metzler.
Nixon.
Prentiss.
Veneziani.

Mathematical Seminary: DR. STORY. Weekly, Wednesday, 4 p. m. (7).

Barcroft.
Cajöri.
Faerber.
Fields.
Metzler.
Peed.
Veneziani.

Theory of Numbers: DR. STORY. Twice weekly, Tuesday and Thursday, 12 m. (9).

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Cajöri.
Cammack.
Faerber.
Fields.
Nixon.
Peed.
Taber.
Veneziani.

Modern Synthetic Geometry: DR. STORY. Three times weekly, Monday, Wednesday, and Friday, 12 m. (8).

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Cajöri.
Faerber.
Fields.
Metzler.
Peed.
Taber.
Veneziani.

Introductory Course for Graduates: DR. STORY. Daily, 10 a. m. (8).

Barcroft.
Cajöri.
Coar.
Lambert.
Metzler.
Nixon.
Perkins, W. H.
Taber.

Conic Sections: DR. STORY. Twice weekly, Tuesday and Thursday, 1 p. m. (21).

Bell.
Cammack.
Crosby.
Dohme.
Duffy.
Eareckson.
Ensey.
Gross.
Laessig.
Love.
McCulloch.
McPherson.
Morris, H. H.
Penniman.
Taber.
Taylor, W. D.
Trower.
Weech.
White, E. L.
Wiegand.
Wingert.

Mathematical Seminary: DR. CRAIG. Weekly, Friday, 4 p. m. (5).

Barcroft.
Cajöri.
Fields.
Nixon.
Veneziani.

Calculus of Variations: DR. CRAIG. Twice weekly, Tuesday and Thursday, 1 p. m. (5).

Crew.
Duncan.
Fields.
Liebig.
Nixon.

Differential Equations: DR. CRAIG. Twice weekly, Tuesday and Thursday, 11 a. m. (16).

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Barcroft.
Blandin.
Coar.
Cole, A. D.
Crew.
Duncan.
Eichelberger.
Gatewood.
Gorton.
Keilholtz.
Love.
McDaniel.
Metzler.
Outen.
Taylor, W. D.

Theory of Functions: DR. CRAIG. Three times weekly, Monday, Wednesday, and Friday, 1 p. m. (5).

Barcroft.
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Nixon.
Veneziani.

Hydrodynamics: DR. CRAIG. Three times weekly, Monday, Wednesday, and Friday, 11 a. m. (6).

Duncan.
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Gatewood.
Liebig.
Morrill.
Nixon.

Problems in Mechanics: DR. FRANKLIN. Twice weekly, Tuesday and Thursday, 9 a. m. (5).

Blandin.
Crew.
Duncan.
Fields.
Keilholtz.

Theory of Equations: DR. FRANKLIN. Three times weekly, Monday, Wednesday, and Friday, 11 a. m. (12).

Ames.
Cammack.
Coar.
Cole, A. D.
Eichelberger.
Gorton.
Gross.
Love.
McCulloch.
McDaniel.
Outen.
Taylor, W. D.

Differential and Integral Calculus: DR. FRANKLIN. Three times weekly, Monday, Wednesday, and Friday, 1 p. m. (19).

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Crosby.
Dohme.
Duffy.
Eareckson.
Ensey.
Gross.
Jastrow.
Laessig.
McCulloch.
McPherson.
Morris, H. H.
Penniman.
Stevens.
Taylor, W. D.
Weech.
White, E. L.
Wiegand.
Wingert.

Differential and Integral Calculus: (Specially designed for students of Physics): MR. NIXON. Daily, 4 p. m. (5).

Beckwith.
Coar.
Cole, A. D.
Lambert.
Stokes, G. C.

Analytical Geometry: DR. FRANKLIN. Twice weekly, Tuesday and Thursday, 4 p. m. (8).

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Hughes.
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Stevens.
Tuska.
Young.

Trigonometry: DR. FRANKLIN. Three times weekly, Monday, Wednesday, and Friday, 4 p. m. (15).

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Bromwell.
Cole, W. R.
Dashiell.
Flexner.
Hoffman.
Jones, W.
Jones, W. A.
Kaessmann.
Rouse.
Rowland.
Trower.
Willis.
White, J.
Winslow.

Physics. (72 Students).

Classes meet in Rooms 3, 4, 7, and 8.

Electricity and Magnetism: PROFESSOR ROWLAND. Daily, 10 a. m. (9).

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Duncan.
Gatewood.
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Liebig.
Mansfield.
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Beckwith.
Black.
Blandin.
Cajöri.
Cammack.
Clark.
Claxton.
Cole, A. D.
Eichelberger.
Fields.
Gatewood.
Gorton.
Hayes.
Hillyer.
Hobbs.
Horner.
Keilholtz.
Laessig.
Lambert.
Love.
McDaniel.
Outen.
Palmer, A. G.
Palmer, C. S.
Peed.
Perkins, W. H.
Roberts, D. E.
Schubart.
Stokes, H. N.
Van Meter.

General Physics: (*Minor Course*): DR. KIMBALL. Daily, 10 a. m. (34).

Applegarth, E. C.
Bayard.
Birney.
Bromwell.
Brune.
Coates.
Dashiell.
Dohme.
Dreyer.
Ensey.
Friedenwald.
Glenn, J.
Gordon, D. H.
Guggenheimer.
Knight.
Lamb.
Loane.
McPherson.
Morris, H. H.
Mount.
O'Donovan.
Price.
Reese.
Shemwell.
Stevens.
Stow.
Straus.
Swartz.
White, E. L.
Williams, J. W.
Williams, L.
Williams, W. K.
Willis.
Wingert.

Laboratory Work: (*Class in General Physics:*) DR. KIMBALL and DR. PERKINS. (34).

Applegarth, E. C.
Bayard.
Birney.
Bromwell.
Brune.
Coates.
Dashiell.
Dohme.
Dreyer.
Ensey.
Friedenwald.
Glenn, J.
Gordon, D. H.
Guggenheimer.
Knight.
Lamb.
Loane.
McPherson.
Morris, H. H.
Mount.
O'Donovan.
Price.
Reese.
Shemwell.
Stevens.
Stow.
Straus.
Swartz.
White, E. L.
Williams, J. W.
Williams, L.
Williams, W. K.
Willis.
Wingert.

Molecular Dynamics: SIR WILLIAM THOMSON. A course of eighteen lectures during October.

This course was followed by a number of professors and students of Physics from other institutions, in addition to many members of the mathematical and physical sections in this University.

Chemistry. (68 Students).

Classes meet in the Chemical Laboratory.

Laboratory Work: PROFESSOR REMSEN, DR. MORSE, and DR. KEISER. Daily. (64).

Aber.
Applegarth, E. C.
Ashe
Bayley.
Bell.
Blandin.
Brackett, R. N.
Buckler.
Campbell.
Canfield.
Clark.
Coar.
Colin.
Davis.
Day.
Dohme.
Duggan.
Emerson, W. H.
Friedenwald.
Gatewood.
Gordon, B. B.
Haldeman.
Hartogensis.
Hayes.
Haynes.
Hemmeter.
Hillyer.
Hitchcock.
Hobbs.
Hough.
Kastle.
Mason.
McIntosh.
McLane, A.
Mindeleff.
Morrill.
Mount.
Orndorff.
Palmer, A. G.
Palmer, C. S.
Penniman.
Perkins, W. H.
Piggot.
Pleasants, J.
Roberts, D. E.
Schaeffer, E. M.
Schubart.
Simpson.
Slack.
Smith.
Stein.
Stokes, G. C.
Swartz.
Trail.
Tyson, J. W.
Wallis.
Waltemeyer.
Wiegand.
Wightman.
Williams, J. W.
Wingert.
Winslow.
Woods.
Yonce.

General Chemistry: PROFESSOR REMSEN. Daily, 9 a. m. (44).

Aber.
Applegarth, E. C.
Ashe.
Bell.
Blandin.
Boucsein.
Buckler.
Clark.
Coar.
Cole, A. D.
Davis.
Dohme.
Easter.
Friedenwald.
Gatewood.
Haldeman.
Hayes.
Hemmeter.
Hitchcock.
Hobbs.
Hough.
Kastle.
Mason.
McLane. A.
McIntosh.
Mindeleff.
Mount.
Morrill.
Penniman.
Perkins, W. H.
Schaeffer, E. M.
Smith.
Stein.
Stokes, G. C.
Swartz.
Tyson, I.
Tyson, J. W.
Wallis.
Waltemeyer.
Wightman.
Williams, J. W
Wingert.
Winslow.
Woods.

Analytical Chemistry: Dr. Morse. Four times weekly, Monday, Tuesday, Wednesday, and Thursday, 9 a. m. (9).

Brackett, R. N. Canfield. Colin. Emerson, W. H. Hartogensis. Palmer, C. S. Roberts, D. E. Slack. Wiegand.

Mineralogy, Etc.

Dr. Williams. (11 Students).

Mineralogy. Weekly, Friday, 2–5 p. m. (3).

Coar. Orndorff. Palmer, C. S.

Petrography. Daily. (Laboratory Work). (2).

Bayley. Lewis.

Geology. Three times weekly, Monday, Tuesday, and Thursday, 12 m. (10).

Bayley. Brackett, R. N. Canfield. Coar. Emerson, W. H. Orndorff. Palmer, C. S. Piggot. Stein. Van Vleck.

Biology.

(41 Students).

Classes meet in the Biological Laboratory,

General Biology: Professor Martin. Three times weekly, Monday, Tuesday, and Thursday, 11 a. m. (21).

Aber. Buckler. Hartogensis. Haynes. Hemmeter. Herrick. Jefferson. Kastle. Mason. MacGoldrick. McIntosh. Patterson. Schaeffer, E. M. Smith. Stein. Stoller. Wallis. Waltemeyer. Wightman. Winslow. Williams, J. W.

Animal Physiology and Histology: Professor Martin. Three times weekly, Monday, Wednesday, and Friday, 10 a. m. (9).

Aber. Campbell. Edmond. Haldeman. Hanna. Hemmeter. Herrick. Stoller. Wiesenfeld.

Advanced Morphology: Dr. Brooks. Twice weekly, Monday and Thursday, 9 a. m. (5).

Andrews. Bruce. McMurrich. Nachtrieb. Nelson.

Mammalian Anatomy: Mr. McMurrich. Twice weekly, Tuesday and Thursday, 10 a. m. (8).

Aber. Campbell. Haldeman. Hemmeter. Herrick. MacGoldrick. Stoller. Wiesenfeld.

Osteology: Mr. McMurrich. Twice weekly, Wednesday and Friday, 11 a. m. (18).

Aber. Buckler. Hartogensis. Haynes. Hemmeter. Herrick. Jefferson. Kastle. Mason. MacGoldrick. McIntosh. Stein. Stoller. Smith. Waltemeyer. Wightman. Williams, J. W. Winslow.

Laboratory Work: Professor Martin, Dr. Brooks, and Mr. Howell. Daily, 9 a. m. to 5 p. m. (35).

Aber. Andrews. Bruce. Buckler. Campbell. Donaldson. Duggan. Edmond. Haldeman. Hanna. Hartogensis. Haynes. Hemmeter. Herrick. Jefferson. Kastle. Kemp. Lee. Mason. MacGoldrick. McClintock. McIntosh. Nachtrieb. Nelson. Patterson. Smith. Stein. Sternberg. Stoller. Wallis. Waltemeyer. Wiesenfeld. Wightman. Williams, J. W. Winslow.

Marine Laboratory: Dr. Brooks. At Beaufort, N. C., during the summer months. (9).

Andrews. Bateson. Conn. Donaldson. Hartwell, E. A. Kemp. Nachtrieb. Nelson. Osborn.

Greek.

(36 Students).

Classes meet in 181 N. Howard Street, unless otherwise specified.

Seminary: Professor Gildersleeve. Twice weekly, Monday and Wednesday, 12 m. (17).

Arnolt. Huizinga. Miller, C. W. E. Pease.

Glenn, W. L. Lodge.

Botsford. Christie. Doubleday. Fossum. Graves. Hussey. Scudder. Slaughter. Walz. Whicher. Zweizig.

Practical Exercises: Professor Gildersleeve. Twice weekly, Tuesday and Friday, 10 a. m. (17).

Arnolt. Botsford. Christie. Doubleday. Fossum. Glenn, W. L. Graves. Huizinga. Hussey. Lodge. Lowry. Pease. Scudder. Slaughter. Walz. Whicher. Zweizig.

Dionysios of Halikarnassos: Professor Gildersleeve. Weekly, Thursday, 12 m. (18).

Arnolt. Botsford. Christie. Doubleday. Fossum. Glenn, W. L. Graves. Huizinga. Hussey. Lodge. Lowry. Miller, C. W. E. Pease. Scudder. Slaughter. Walz. Whicher. Zweizig.

Plato: *Gorgias:* Professor C. D. Morris. Four times weekly, T
day, Wednesday, Thursday, and Friday, 12 m. (8).

Gardner, W. Harry. Hodges. Horner. Hough. Hughes. Lowry. McLane, A.

Isocrates, i, iv: Dr. Spieker. Four times weekly, Tues
Wednesday, Thursday, and Friday, 11 a. m. (9).

Cole, W. R. Flexner. Hoffman. Jackson. Jones, W. A. Kaessmann. McLane, R. M. Rogers. Thompson.

Prose Composition:

Class A: Professor C. D. Morris. Weekly, Monday, 12 m. (8

Gardner, W. Harry. Hodges. Horner. Hough. Hughes. Lowry. McLane, A.

Class B: Dr. Spieker. Weekly, Monday, 11 a. m. (9).

Cole, W. R. Flexner. Hoffmann. Jackson. Kaessmann. Jones, W. A. McLane, R. M. Rogers. Thompson.

New Testament Greek: (*Gospel of Mark*): Mr. Harris. T
hours weekly, Monday, 10–11 a. m., Wednesday and Friday, 9–11 a
187 N. Howard St. (3).

Lowry. Newton. Rogers.

Sub-Apostolic Literature: Mr. Harris. Three hours wee
Tuesday, 10–11 a. m., Thursday, 10 a. m.–12 m. 187 N. Howard St.

Lowry. Newton. Rogers.

Classical Archæology: Dr. Emerson. Weekly. (Beginning in November).

Supplementary Class: Professor C. D. Morris. Twice wee
Tuesday and Thursday, 2 p. m. (5).

Eareckson. Flexner. Gilpin. Jones, W. A. Kaessmann.

Latin.

(59 Students).

Classes meet in 181 N. Howard St.

Seminary: *Horace and Juvenal:* Dr. Warren. Twice weekly, T
day and Friday, 11 a. m. (16).

Botsford. Bowen. Bugg. Fontaine. Fossum. Gardner, W. Glenn, W. L. Graves. Hussey. Lodge. Pease. Scudder. Slaughter. Walz. Whicher. Zweizig.

Roman Satirists: Dr. Warren. (Lectures). Weekly, Thurs
11 a. m. (16).

Botsford. Bowen. Bugg. Fontaine. Fossum. Gardner, W. Glenn, W. L. Graves. Hussey. Lodge. Pease. Scudder. Slaughter. Walz. Whicher. Zweizig.

Plautus and Terence: Dr. Warren. Four times wee
Tuesday, Wednesday, Thursday, and Friday, 10 a. m. (6).

Harrison. Harry. Hodges. Hough. McLane, A. Pleasants, J.

(The meetings on Wednesday are devoted to reading Latin at sight).

Cicero: (*De Orat., i: Tusc. Disp., i*): Professor C. D. Morris. F
times weekly, Tuesday, Wednesday, Thursday, and Friday, 10 a. m.

English. Jackson. Hughes. Roberts, B.

(The meetings on Wednesday are devoted to reading Latin at sight).

Livy, ii, iii: Dr. Spieker. Four times weekly, Tuesday, Wed
day, Thursday, and Friday, 9 a. m. (16).

Brune. Cole, W. R. Dreyer. Fifield. Flexner. Guggenheimer. Hoffmann. Jones, W. A. Kaessmann. McLane, R. M. McPherson. Preston. Rogers. Thompson. Trower. Tuska.

(The meetings on Wednesday are devoted to reading Latin at sight).

Prose Composition:

Class A: Dr. Warren. Weekly, Monday, 10 a. m. (5).

Harry. Hodges. Hough. McLane, A. Pleasants, J.

Class B: Professor C. D. Morris. Weekly, Monday, 10 a. m.

English. Jackson. Hughes. Roberts, B.

Class C: Dr. Spieker. Weekly, Monday, 9 a. m. (12).

Cole, W. R. Dreyer. Flexner. Hoffmann. Jones, W. A. Kaessmann. McLane, R. M. McPherson. Preston. Rogers. Thompson. Trower.

Classical Antiquities: Dr. Emerson. Twice weekly, Tues
and Friday, 9 a. m. (8).

Botsford. Harry. Hodges. Horner. Hughes. Loane. Newton. Roberts, B.

Supplementary Class: Mr. Slaughter. Three times wee
Monday, Wednesday, and Friday, 2 p. m. (14).

Crosby. Duffy. Friedenwald. Gilpin. Jones, W. Laessig. Mount. Penniman. Rouse. Rowland. Weech. White, J. Wiegand. Young.

Shemitic Languages. PROFESSOR HAUPT. (12 students).

Classes meet in 113 W. Monument St.

Hebrew for Beginners. Twice weekly, Monday and Friday, 4 p. m. (7).

Adler. Arnolt. Frothingham. Grape. Huizinga. Miller, C. W. E. Rogers.

Hebrew Exercises. Weekly, Wednesday, 3 p. m. (6).

Adler. Arnolt. Frothingham. Grape. Huizinga. Rogers.

Selected Psalms. Weekly, Tuesday, 4 p. m. (8).

Adler. Arnolt. Frothingham. Grape. Harris. Huizinga. Philipson. Rogers.

Chaldean Grammar. Weekly, Wednesday, 4 p. m. (7).

Adler. Arnolt. Frothingham. Grape. Harris. Huizinga. Philipson.

Ethiopic. Weekly, Thursday, 4 p. m. (8).

Adler. Arnolt. Frothingham. Grape. Huizinga. Newman. O'Conor. Philipson.

Arabic. Weekly, Tuesday, 3 p. m. (6).

Adler. Arnolt. Frothingham. Huizinga. Philipson. Wood, H.

Assyrian. Three hours weekly, Thursday, 10 and 11 a. m., and 3 p. m. (7).

Adler. Arnolt. Frothingham. Huizinga. Newman. O'Conor. Philipson.

Sanskrit and the comparative grammar of the cognate languages. DR. BLOOMFIELD. (19 Students).

Classes meet in 113 W. Monument St., unless otherwise specified.

Elementary Sanskrit: (*Whitney's Grammar, Lanman's Reader*). Twice weekly, Monday, 11 a. m., Friday, 12 m. (11).

Botsford. Christie. Cobb. Doubleday. Fossum. Hussey. Lodge. Miller, C. W. E. Scudder. Walz. Whicher.

Vedic Sanskrit: Weekly, Saturday, 10 a. m. (2).

Spicker. Todd.

Comparative Philology: (*Lectures, and Whitney's Language and the Study of Language*). Weekly, Wednesday, 4 p. m. (6).

Christie. Cobb. Doubleday. Dunlap. Hempl. Hubbard.

Comparative Grammar of Greek Vocalism: (*Lectures*). Weekly, Monday, 4 p. m., in Bentley Hall. (11).

Botsford. Christie. Cobb. Doubleday. Emerson, A. Hussey. Lodge. Pease. Scudder. Slaughter. Whicher.

German. (96 Students).

Classes meet in 117 W. Monument St.

Gothic: (*Braune's Grammar*): DR. WOOD. Twice weekly, Monday and Thursday, 9 a. m. (8).

Burton. Cobb. Dunlap. Gates. Hempl. Learned. Lerch. Matzke.

Middle High German: (*Paul's Grammar; Walther von der Vogelweide*): DR. WOOD. Weekly, Thursday, 12 m. (5).

Cobb. Hempl. Learned. Lerch. Matzke.

Old High German: (*Hahn's Grammar; Braune's Reader*): DR. WOOD. Weekly, Wednesday, 12 m. (7).

Cobb. Egge. Hempl. Learned. Lerch. Matzke. Wright.

(*Major Course*).

German Literature: *Lectures, with Kluge's Geschichte der Deutschen Literatur:* DR. WOOD. Weekly, Friday, 10 a. m. (18).

Burton. Cammack. Dunlap. Egge. Eichelberger. Flexner. Gates. Gorton. Hartogensis. Hubbard. Laessig. Lerch. Matzke. McDaniel. Schaefer, J. Waltemeyer. Wright. Young.

Goethe: *Hermann und Dorothea:* MR. HEMPL. Twice weekly, Monday and Thursday, 10 a. m. (18).

Bugg. Doub. Dunlap. Eichelberger. Fifield. Flexner. Gates. Gardner, W. Gorton. Hartogensis. Hubbard. Laessig. McDaniel. Scudder. Schaefer, J. Tuska. Waltemeyer. Young.

Prose Composition: DR. WOOD. Weekly, Wednesday, 10 a. m. (13).

Bugg. Cobb. Eichelberger. Flexner. Gardner, W. Gates. Howard. Laessig. Lerch. McDaniel. Schaefer, J. Waltemeyer. Young.

Selected Readings: (*Masius' Lesebuch, iii*): DR. WOOD. Weekly, Tuesday, 10 a. m. (13).

Cammack. Cobb. Eichelberger. Fifield. Flexner. Gorton. Hartogensis. Howard. Laessig. McDaniel. Schaefer, J. Waltemeyer. Young.

Exercises in German Style: DR. WOOD. Second Monday of each month, 4 p. m. (8).

Eichelberger. Flexner. Gorton. Laessig. McDaniel. Schaefer, J. Tuska. Waltemeyer.

(*Minor Course*).

Lessing: *Minna von Barnhelm:* ***Goethe:*** *Prosa:* MR. HEMPL.

First Section. Twice weekly, Monday and Wednesday, 11 a. m. (22).

Beckwith. Bevan. Birney. Bromwell. Claxton. Coates. Cobb. Crosby. Doubleday. Dunlap. Eareckson. Gordon, D. H. Harry. McLane, R. M. Penniman. Sato. Stow. Straus. Trower. Tuska. White, E. L. Willis.

Second Section. Twice weekly, Monday and Wednesday, 3 p. m. (11).

Cobb. Doubleday. Duffy. Ferguson. Hayes. McMahon. Morris, H. H. O'Donovan. Reese. Roberts, D. E. Weech.

Selected Readings: (*Oltrogge's Lesebuch, ii*): DR. WOOD and MR. HEMPL. (*Two Sections*). Weekly, Friday, 11 a. m. (34).

Beckwith. Bevan. Birney. Bromwell. Coates. Claxton. Crosby. Doubleday. Duffy. Dunlap. Eareckson. Ferguson. Gordon, D. H. Harry. Hayes. Hubbard. Lewis. Lichty. McLane, A. Morris, H. H. O'Donovan. Penniman. Perkins, C. A. Randall. Reese. Roberts, D. E. Sato. Stow. Straus. Trower. Tuska. Weech. White, E. L. Willis.

Prose Composition: MR. HEMPL. Weekly, Thursday, 11 a. m. (31).

Beckwith. Bevan. Birney. Bromwell. Coates. Crosby. Doubleday. Duffy. Dunlap. Eareckson. Ferguson. Gordon, D. H. Harry. Hayes. Hubbard. McLane, A. McMahon. Morris, H. H. O'Donovan. Penniman. Perkins, C. A. Reese. Roberts, D. E. Sato. Stow. Straus. Trower. Tuska. Weech. White, E. L. Willis.

Oral Practice: DR. WOOD. Weekly, Tuesday, 11 a. m. (25).

Beckwith. Bevan. Birney. Bromwell. Coates. Crosby. Doubleday. Duffy. Eareckson. Gordon, D. H. Harry. Hubbard. Lewis. McLane, A. Morris, H. H. O'Donovan. Penniman. Perkins, C A. Reese. Straus. Trower. Tuska. Weech. White, E. L. Willis.

Conversation Class: DR. GERBER. Daily, Monday, Tuesday, and Friday, 12 m.; Wednesday and Thursday, 9 a. m. (21).

Bugg. Cobb. Doub. Eichelberger. Gardner, W. Gorton. Graves. Hartogensis. Haynes. Horner. Learned. Loane. Lodge. McDaniel. Pease. Perkins, C. A. Slaughter. Stokes. Tuska. Woods. Young.

Supplementary Classes:

First Section: Brandt's Grammar, Deutsch's Reader: MR. HEMPL. Three times weekly, Monday, Tuesday, and Thursday, 4 p. m. (11).

Barcroft. Duncan. Emerson, W. H. Fields. Lewis. McIntosh. Nixon. Powell. Taylor, W. D. Van Vleck. Wightman.

Second Section: Otis' Elementary German: MR. HEMPL. Five times fortnightly, Tuesday, Thursday, and alternate Fridays, 3 p. m. (17).

Carter Dashiell. Dorsey. Ensey. Ferguson. Hahn. Hodges. Hughes. Knight. Lamb. Lowndes. Preston. Reeves. Roberts, D. E. Rowland. Shemwell. White, J.

Romance Languages. (59 Students).

Classes meet in 111 and 117 W. Monument St.

Advanced Courses: (*Old French Seminary; Romance Languages in Europe; Langue d'oïl Dialects; Comparative Phonology of the Romance Languages*): MR. ELLIOTT. (4 classes). Wednesday, 10–12 m.; Monday, 11 a. m.; Monday, 10 a. m.; Wednesday, 9 a. m. (5).

Bowen. Fontaine. Perkins, C. A. Todd. Veneziani.

Advanced Courses: (*Aucassin et Nicolete; French Phonetics*): MR. ELLIOTT. (2 classes). Monday, 12 m., Tuesday, 1 p. m. (6).

Bevan.
Bugg.
Learned.
Perkins, C. A.
Reeves.
Veneziani.

Advanced Courses: *Catalan: Portuguese: Old Provençal:* MR. TODD. (3 classes). Wednesday, Thursday, and Friday, 1 p. m. (4).

Bevan.
Bugg.
Learned.
Perkins, C. A.

Italian: MR. TODD. Three times weekly, Monday, 1 p. m., Tuesday and Wednesday, 9 a. m. (8).

Bevan.
Bugg.
Egge.
Fossum.
Howard.
Learned.
Matzke.
Van Meter.

Spanish: MR. TODD. Twice weekly, Thursday and Friday, 9 a. m. (4).

Bevan.
Bugg.
Learned.
Van Meter.

French: Major Course: (*Bartsch's Old French Chrestomathie*): MR. TODD. Daily, 10 a. m. (4).

Bugg.
Learned.
Perkins, C. A.
Veneziani.

French: Minor Course: (3 classes). MR. TODD (*Literary Course*), Wednesday and Thursday, 12 m.; MR. BOWEN (*Historical and Scientific Courses*), Tuesday and Friday, 12 m.; MR. FONTAINE (*Composition*), Monday, 11 a. m. (12).

Ames.
Beckwith.
Buckler.
English.
Harrison.
Howard.
Lichty.
Lowndes.
Matzke.
Pleasants, R. H.
Reeves.
Winslow.

French Conversation: MR. FONTAINE. Daily, 3 p. m. (25).

Ames.
Beckwith.
Birney.
Dreyer.
Eareckson.
English.
Ferguson.
Fifield.
Guggenheimer.
Harrison.
Hartogensis.
Hobbs.
Howard.
Hubbard.
Learned.
Lowndes.
Matzke.
Penniman.
Pleasants, R. H.
Reeves.
Rogers.
Sato.
Schubart.
Steiner.
Winslow.

Supplementary Class: MR. BOWEN. Five times fortnightly, Monday, Wednesday, and Friday, 3 p. m. (28).

Bayard.
Birney.
Brack.
Dorsey.
Doub.
Eareckson.
Ensey.
Ferguson.
Hobbs
Hodges.
Hubbard.
Hughes.
Lamb.
Mindeleff.
Preston.
Rouse.
Rowland.
Sato.
Shemwell.
Stevens.
Stokes, G. C.
Straus.
Taylor, F. M.
Taylor, W. D.
Tuska.
Waltemeyer.
Woods.
Young.

English and Anglo-Saxon. (66 Students).

Classes meet in 111 and 117 W. Monument St.

Anglo-Saxon: *Béowulf:* DR. WOOD. Weekly, Wednesday, 9 a. m. (7).

Burton.
Cobb.
Dunlap.
Gates.
Hempl.
Learned.
Lerch.

English Literature: (*Minor Course*): *Shakespeare:* DR. BROWNE. Twice weekly, Tuesday and Friday, 11 a. m. (9).

Applegarth, A. C.
Burton.
Brackett, J. R.
Cobb.
Marks.
Noyes.
Reeves.
Van Meter.
Wood, J.

Anglo-Saxon: (*Sweet's Reader; Sievers' Grammar*): MR. WRIGHT. Twice weekly, Tuesday and Friday, 4 p. m. (6).

Claxton.
Fossum.
Hubbard.
Learned.
Matzke.
Van Meter.

Early English: (*Morris's Specimens, Part I*): MR. EGGE. Twice weekly, Tuesday and Friday, 9 a. m. (7).

Burton.
Claxton.
Cobb.
Dunlap.
Hubbard.
Learned.
Van Meter.

English Literature: (*P. H. E. Course*): DR. BROWNE. Twice weekly, Wednesday and Thursday, 12 m. (50).

Applegarth, E. C.
Birney.
Brack.
Bromwell.
Brune.
Carter.
Coates.
Cole, W. R.
Crosby.
Dashiell.
Dorsey.
Dreyer.
Duffy.
Eareckson.
Ferguson.
Fifield.
Flexner.
Friedenwald.
Gilpin.
Gordon, D. H.
Guggenheimer.
Hoffmann.
Jackson.
Jones, W. A.
Kaessmann.
Knight.
Laessig.
Loane.
McLane, R. M.
McPherson.
Marks.
Morris, H. H.
O'Donovan.
Preston.
Reese.
Roberts, B. T.
Rogers.
Rouse.
Rowland.
Shaefer, J.
Shemwell.
Stow.
Straus.
Thompson.
Trower.
Tuska.
Weech.
White, E. L.
White, J.
Williams, J. W.
Willis.
Young.

History and Political Science. (104 Students).

Classes meet in rooms of the Bluntschli Library, unless otherwise specified.

Seminary of History and Politics: DR. ADAMS. Weekly, Friday, 8 p. m. (30).

Applegarth, A. C.
Berry.
Bonsal.
Brackett, J. R.
Coler.
Dewey.
Egge.
Fossum.
Gardner, H. B.
Goodman.
Gould.
Holcomb.
Howard.
Johnson.
Levermore.
Lichty.
McMahon.
Morris, C. N.
Newton.
Ota.
Powell.
Randall.
Robinson.
Sato.
Scaife.
Steiguer.
Taylor, F. M.
Wilson, W.
Wood, J.
Worthington.

History of Politics: DR. ADAMS. Three times weekly, Wednesday, Thursday, and Friday, 10 a. m. (25).

Applegarth, A. C.
Berry.
Brackett, J. R.
Coler.
Dewey.
Fossum.
Gardner, H. B.
Holcomb.
Howard.
Levermore.
Lichty.
McMahon.
Morris, C. N.
Newton.
Ota.
Powell.
Randall.
Sato.
Scaife.
Steiguer.
Taylor, F. M.
Wilson, W.
Wood, J.
Woodward.
Worthington.

Church History: DR. ADAMS. Twice weekly, Monday and Tuesday, 11 a. m. (21).

Brack.
Coler.
Doub.
Egge
Gardner, H. B.
Lerch.
McMahon.
Morris, C. N.
Newton.
Ota.
Pleasants, R. H.
Price.
Schaefer, J.
Taylor, F. M.
Van Meter.
Van Vleck.
Williams, L.
Williams, W. K.
Wiesenfeld.
Wood, J.
Woods.

International Law: DR. ADAMS. Twice weekly, Monday and Tuesday, 12 m. (9).

Applegarth, A. C.
Claxton.
Coler.
Gates.
Howard.
Price.
Ryttenberg.
Steiner.
Van Meter.

Money, Banking, Finance and Commerce: (*Lectures*): DR. ELY. Three times weekly, Wednesday, Thursday, and Friday, 12 m. (22).

Applegarth, A. C.
Berry.
Dewey.
Gardner, H. B.
Holcomb.
Howard.
Levermore.
Lichty.
McMahon.
Miller, E. G.
Morris, C. N.
Ota.
Powell.
Randall.
Sato.
Scaife.
Swift.
Taylor, F. M.
Van Meter.
Wilson, W.
Wood, J.
Worthington.

English Constitution: DR. JAMESON. Three times weekly, Wednesday, Thursday, and Friday, 12 m. (5).

Claxton.
Gates.
Price.
Ryttenberg.
Steiner.

English and French History: DR. JAMESON. Three times weekly, Wednesday, Thursday, and Friday, 11 a. m. (13).

Brack.
Coler.
Doub.
Egge.
Glenn, J.
Lerch.
Pleasants, R. H.
Price.
Schaefer, J.
Wiesenfeld.
Williams, L.
Williams, W. K.
Woods.

Elements of Political Economy: DR. ELY. Daily, 1 p. m. (19).

Bayard.
Coates.
Doub.
Ferguson.
Fifield.
Gates.
Glenn, J.
Loane.
Pleasants, J.
Pleasants, R. H.
Ryttenberg.
Sams.
Steiner.
Swift.
Van Meter.
Wiesenfeld.
Williams, L.
Williams, W. K.
Woods.

Thucydides: (*in translations*): PROFESSOR C. D. MORRIS. Weekly, Monday, 9 a. m., in 181 N. Howard St. (5).

Coates.
Guggenheimer.
Schaefer, J.
Tuska.
Young.

Introductory Course: (*P. H. E.*): DR. ADAMS. Weekly, Friday, 12 m. (52).

Applegarth, E. C.
Birney.
Brack.
Bromwell.
Brune.
Carter.
Coates.
Cole, W. R.
Crosby.
Dashiell.
Dorsey.
Dreyer.
Duffy.
Eareckson.
Ferguson.
Fifield.
Flexner.
Friedenwald.
Gilpin.
Guggenheimer.
Hoffmann.
Jackson.
Jones, W. A.
Kaessmann.
Knight.
Lamb.
Laessig.
Marks.
McLane, R. M.
McPherson.
Morris, H. H.
O'Donovan.
Preston.
Reese.
Roberts, D. E.
Rogers.
Rouse.
Rowland.
Schaefer, J.
Shemwell.
Smith.
Stow.
Straus.
Thompson.
Trower.
Tuska.
Weech.
White, E. L.
White, J.
Williams, J. W.
Willis.
Young.

Greek and Roman History: (*P. H. E. Course*): DR. JAMESON. Twice weekly, Monday and Tuesday, 12 m. (47).

Applegarth, E. C.
Birney.
Brack.
Bromwell.
Brune.
Coates.
Cole, W. R.
Crosby.
Dorsey.
Dreyer.
Duffy.
Eareckson.
Ferguson.
Flexner.
Friedenwald.
Gilpin.
Gordon, D. H.
Guggenheimer.
Hoffmann.
Jackson.
Jones, W. A.
Kaessmann.
Knight.
Laessig.
Lamb.
Marks.
McLane, R. M.
McPherson.
Morris, H. H.
O'Donovan.
Preston.
Reese.
Roberts, D. E.
Rogers.
Rouse.
Rowland.
Schaefer, J.
Shemwell.
Stow.
Straus.
Thompson.
Trower.
Weech.
White, E. L.
White, J.
Williams, J. W.
Willis.

Psychology and Pedagogics. PROFESSOR HALL. (37 Students).

Classes meet in the Biological Laboratory.

Psychology. Twice weekly, Monday and Tuesday, 12 m. (21).

Andrews.
Bruce.
Burton.
Campbell.
Colin.
Edmond.
Gross.
Hanna.
Hemmeter.
Jastrow.
Kemp.
Lee.
Lichty.
McClintock.
McCulloch.
Nelson.
Newton.
Noyes.
Scaife.
Steiguer.
Swift.

CHECK LIST OF STUDENTS.

[(F) Fellows; *Students not connected with the university during the last academic year].

GRADUATE STUDENTS.

NAME.	RESIDENCE.	FROM WHAT INSTITUTION.	PRINCIPAL SUBJECTS.	CITY ADDRESS.
Aber, W. M.*	Waterbury, Ct.	Yale.	*Physics, Chemistry, etc.*	82 Bolton St.
Adler, C.	Philadelphia, Pa.	Univ. of Pa.	*Shemitic Languages.*	352 Linden Av.
Andrews, E. A. (F)	New York City.	Yale.	*Biology.*	212 W. Hoffman St.
Applegarth, A. C.	Baltimore.	J. H. U.	*Hist. and Pol. Science.*	632 W. Fayette St.
Arnolt, W. M. (F)	New Brunswick, N. J.	New Brunswick Th'l Sem.	*Greek.*	70 Cathedral St.
Baden, W. W.	Baltimore.	J. H. U.	*Latin and Greek.*	51 W. Fayette St.
Barcroft, D.*	Berkeley, Cal.	Univ. of Cal.	*Mathematics.*	78 Saratoga St.
Bateson, W.	Cambridge, Eng.	Univ. of Cambridge.	*Marine Laboratory.*	[Beaufort, N. C.]
Bayley, W. S.	Baltimore.	J. H. U.	*Chemistry and Mineralogy.*	366 North Av., W.
Beckwith, E. G.*	Wake Forest, N. C.	Wake Forest College.	*Physics.*	134 N. Eutaw St.
Bell, L.*	New York City.	Dartmouth.	*Physics.*	16 McCulloh St.
Berry, T. A.	Baltimore.	J. H. U.	*Hist. and Pol. Science.*	247 Bolton St.
Bissing, G. (F. by C.)	Baltimore.	J. H. U.	*Mathematics.*	264 W. Lombard St.
Black, C. H.*	U. S. N.	U. S. Naval Acad.	*Physics.*	254 N. Calvert St.
Blandin, J. J.*	Selma, Ala.	U. S. Naval Acad.	*Physics.*	The Albion.
Bonsal, L.*	Baltimore.	Harvard.	*History (Sem.)*	236 N. Charles St.
Botsford, G. W.*	Lincoln, Neb.	Univ. of Nebraska.	*Greek and Latin.*	130 N. Eutaw St.
Bowen, B. L.	Chili Station, N. Y.	Univ. of Rochester.	*Romance Languages.*	4 McCulloh St.
Brackett, J. R.*	Quincy, Mass.	Harvard.	*History, etc.*	22 Cathedral St.
Brackett, R. N.	Charleston, S. C.	Davidson.	*Chemistry and Mineralogy.*	266 N. Howard St.
Bright, J. W.* (F. by C.)	Lockhaven, Pa.	Lafayette.	*English.*	213 W. Biddle St.
Bruce, A. T.	New York City.	Princeton.	*Biology.*	87 Park Av.
Bugg, Q. T.*	Homer, La.	Washington and Lee.	*Romance Languages.*	4 McCulloh St.
Burton, R. E.	Hartford, Conn.	Trinity.	*English.*	87 Park Av.
Cajöri, F.	Switzerland.	Univ. of Wisconsin.	*Mathematics.*	134 N. Eutaw St.
Cammack, I. I.*	Deming, Ind.	Earlham.	*Mathematics.*	167 Paca St.
Canfield, W. B.	Baltimore.	J. H. U.	*Chemistry.*	43 Cathedral St.
Christie, F. A.*	Boston, Mass.	Amherst.	*Greek and Sanskrit.*	54 McCulloh St.
Clark, T. H.*	Shirley, Mass.	Worcester Free Inst.	*Chemistry.*	266 N. Howard St.
Claxton, P. P.*	Shelbyville, Tenn.	Univ. of Tennessee.	*Teutonic Languages.*	4 McCulloh St.
Coar, H. L.*	Cologne, Germany.	Cologne Gymnasium.	*Mathematics.*	226 Druid Hill Av.
Cobb, J. T.	Richmond, Ky.	Central Univ. (Ky.)	*Teutonic Languages.*	212 W. Hoffman St.
Cole, A. D.*	Beverly, Mass.	Brown.	*Physics.*	263 N. Howard St.
Coler, G. P.*	Athens, Ohio.	Ohio Univ.	*History, Philosophy, etc.*	218 Linden Av.
Colin, T. F.*	St. Petersburg, Russia.	Univ. of St. Petersburg.	*Physics and Chem.*	70 Cathedral St.
Conn, H. W.	Fitchburg, Mass.	Boston Univ.	*Marine Laboratory.*	[Beaufort, N. C.]
Crew, H. (F)*	Wilmington, O.	Princeton.	*Physics.*	8 McCulloh St.
Day, D. T.	Baltimore.	J. H. U.	*Chemistry.*	266 N. Howard St.
Dewey, D. R.	Burlington, Vt.	Univ. of Vermont.	*Hist. and Pol. Science.*	181 Linden Av.
Doubleday, C. A.*	Montclair, N. J.	Amherst.	*Greek, etc.*	52 McCulloh St.
Duggan, J. R. (F)	Macon, Ga.	Mercer Univ.	*Chemistry.*	330 N. Eutaw St.
Duncan, L.	Baltimore.	U. S. Naval Acad.	*Physics and Mathematics.*	202 Druid Hill Av.
Dunlap, C. G.	Chillicothe, O.	Ohio Wesleyan.	*English.*	266 N. Howard St.
Donaldson, H. H. (F. by C.)	New York City.	Yale.	*Biology.*	112 St. Paul St.
Edmond, G. W.	Portland, Me.	J. H. U.	*Biology.*	267 N. Eutaw St.
Egge, A. E.	Decorah, Ia.	Norwegian Luther.	*English.*	8 McCulloh St.
Emerson, W. H.	Tunnel Hill, Ga.	U. S. Naval Acad.	*Chemistry and Physics.*	202 Druid Hill Av.
Faerber, J. I.	Gitomir, Russia.	Univ. of Dorpat.	*Mathematics.*	70 Cathedral St.
Fields, J. C.*	Hamilton, Canada.	Univ. of Toronto.	*Mathematics.*	19 McCulloh St.
Fisher, J. A.	Baltimore.	Ill. Wesleyan Univ.	*History and Philosophy.*	85 McCulloh St.
Fontaine, J. A.	Bué, France.	College of Nancy (France).	*Romance Languages.*	1 McCulloh St.
Fossum, A.	Elon, Iowa.	Norwegian Luther.	*Greek and History.*	167 N. Paca St.
Frothingham, A. L. (F)	Rome, Italy.	Leipsic.	*Shemitic Languages.*	29 Cathedral St.
Gardner, H. B.*	Providence, R. I.	Brown.	*Hist. and Pol. Science.*	132 W. Madison St.
Gardner, W., Jr.*	Greencastle, Iowa.	Illinois College.	*Latin, Greek, etc.*	4 McCulloh St.
Gatewood, R. W.*	Norfolk, Va.	U. S. Naval Acad.	*Physics and Chemistry.*	125 Park Av.
Gerber, A. (F. by C.)	Germany.	Univ. of Munich.	*Teutonic Languages.*	213 W. Biddle St.
Glenn, W. L.	Baltimore.	J. H. U.	*Greek.*	153 N. Charles St.
Goodman, E.	Baltimore.	J. H. U.	*History (Sem.)*	322 Hollins St.
Gould, E. R. L.	Oshawa, Ont.	Victoria Univ.	*History (Sem.)*	Washington D. C.
Graves, W. S.	Liberty, Va.	Washington and Lee.	*Greek and Latin.*	132 W. Madison St.
Gross, A. H.*	Whitby, Ont.	Univ. of Toronto.	*Philosophy.*	52 McCulloh St.
Haldeman, G. B.	Cedarville, Ill.	Beloit.	*Biology.*	16 McCulloh St.
Hall, C. C.	Baltimore.		*Physics and Mathematics.*	142 Park Av.
Hanna, A. A.	Baltimore.	Univ. of Maryland.	*Biology.*	73 Charles St. Av.
Harrison, G.	Baltimore.	Princeton.	*Languages.*	90 Read St.
Hartwell, E. A.*	Fitchburg, Mass.		*Marine Laboratory.*	[Beaufort, N. C.]

NAME.	RESIDENCE.	FROM WHAT INSTITUTION.	PRINCIPAL SUBJECTS.	CITY ADDRESS.
AWAY, A. S. (F. by C.)	Decatur, Mich.	Cornell.	*Mathematics.*	201 N. Howard St.
S, C. W.*	Hanover, O.	Oberlin.	*Chemistry.*	203 N. Howard St.
ES, E.*	Portland, Ind.	Worcester Free Inst.	*Biology and Chemistry.*	106 N. Eutaw St.
IETER J. C.*	Baltimore.	Univ. of Maryland.	*Biology and Chemistry.*	204 German St.
ICK, F. H.*	Tilton, N. H.	Dartmouth.	*Biology.*	16 McCulloh St.
YER, H. W. (F)	Waupun, Wis.	Univ. of Wisconsin.	*Chemistry.*	283 Park Av.
ICOCK, G. G.*	Lincoln, Neb.	Univ. of Nebraska.	*Physics and Chemistry.*	333 N. Eutaw St.
S, W. H.*	Auburn, Mass.	Worcester Free Inst.	*Chemistry and Physics.*	266 N. Howard St.
, W. S.*	Washington, D. C.	U. S. Naval Acad.	*Physics and Chemistry.*	Washington, D. C.
OMB, W. P.	Newtown, Pa.	Swarthmore.	*Hist. and Pol. Science.*	48 McCulloh St.
RD, C. H.	Baltimore.	J. H. U.	*History and German.*	101 N. Charles St.
ARD, F. G.*	Oswego, N. Y.	Williams.	*English.*	118 W. Biddle St.
NGA, A. H. (F)	Zeeland, Mich.	Hope College.	*Shemitic Languages.*	70 Cathedral St.
EY, G. B.*	E. Orange, N. J.	Columbia.	*Greek.*	24 McCulloh St.
OW, J.	Philadelphia.	Univ. of Pa.	*Psychology and Logic.*	256 W. Lombard St.
SON, J.	Baltimore Co.	J. H. U.	*History (Sem.)*	McDonogh P. O.
LE, J. H.*	Lexington, Ky.	Ky. State College.	*Chemistry and Biology.*	330 N. Eutaw St.
HOLTZ, P. O.*	Baltimore.	U. S. Naval Acad.	*Physics.*	356 N. Charles St.
, G. T.	Baltimore.	J. H. U.	*Biology.*	55 N. Green St.
ERT, M. B.*	Riegelsville, Pa.	Lafayette.	*Mathematics and Physics.*	147 Mulberry St.
NED, M. D.*	Dover, Del.	Dickinson.	*Modern Languages.*	247 Linden Av.
F. S. (F)	Canton, N. Y.	St. Lawrence Univ.	*Biology.*	122 Cathedral St.
H, C. H.*	Easton, Pa.	Lafayette.	*English.*	24 McCulloh St.
RMORE, C. H. (F)	New Haven, Conn.	Yale.	*Hist. and Pol. Science.*	330 Maryland Av.
, H. C.* (F. by C.)	Germantown, Pa.	Univ. of Pa.	*Mineralogy.*	St. James Hotel.
Y, W. H.*	Lincoln, Neb.	Univ. of Nebraska.	*Hist. and Pol. Science.*	130 N. Eutaw St.
G, G. A., JR. (F)	Baltimore.	J. H. U.	*Physics.*	307 St. Paul St.
E, G.	Baltimore.	J. H. U.	*Greek and Latin.*	445 N. Mount St.
J. L.*	Gastonia, N. C.	Univ. of N. C.	*Mathematics and Physics.*	201 N. Howard St.
Y, W. S.*	Smithville, Va.	S. C. Theol. Sem.	*Greek, German, etc.*	129 Bolton St.
OLDRICK, D. J.*	Woodstock.	[Woodstock College].	*Biology.*	Loyola College.
FIELD, J. M.*	Mt. Pleasant, Iowa.	Iowa Wesleyan.	*Mathematics and Physics.*	160 Druid Hill Av.
KE, J. E.*	Baileyville, Ill.	Hope Coll.	*Modern Languages.*	134 N. Eutaw St.
INTOCK, C. T.	Millersburg, Ky.	Ky. Wesleyan.	*Biology, etc.*	330 N. Eutaw St.
LLOCH, J. F.*	Pleasant Garden, N. C.	Adrian Coll.	*Mathematics.*	19 McCulloh St.
NIEL, W. R.	St. Michael's.	Western Maryland.	*Mathematics.*	367 Eutaw Place.
TOSH, J. H.*	Newberry, S. C.	Newberry.	*Chemistry and Biology.*	330 N. Eutaw St.
HON, R. F.*	Cambridge, O.	Princeton.	*History, etc.*	209 N. Howard St.
RRICH, J. P.*	Toronto, Canada.	Univ. of Toronto.	*Biology.*	181 Linden Av.
LER, G. F.*	Odessa, Canada.	Albert College.	*Mathematics.*	63 St. Paul St.
ER, C. W. E. (F)	Baltimore.	J. H. U.	*Greek.*	306 S. Sharp St.
ER, E. G., JR.	Baltimore.	J. H. U.	*Hist. and Pol. Science.*	279 W. Baltimore St.
ILL, P.	Loudon, N. H.	Amherst.	*Physics.*	47 Courtland St.
IS, C. N.*	West Hartford, Ct.	Yale.	*Hist. and Pol. Science.*	20 Cathedral St.
TRIEB, H. F. (F)	St. Paul, Minn.	Univ. of Minn.	*Biology.*	213 W. Biddle St.
N, J.	Waupaca, Wis.	Univ. of Wisconsin.	*Biology.*	134 N. Eutaw St.
IAN, J.*	Osco, Ill.		*Shemitic Languages.*	Darlington.
ON, J. C.*	Millersburg, Ky.	Ky. Mil. Inst.	*Philosophy and Pedagogy.*	69 Preston St.
, H. B. (F)	Winfall, N. C.	Univ. of N. C.	*Mathematics and Physics.*	212 W. Hoffman St.
, W., JR.* (F)	Malden, Mass.	Harvard.	*Psychology.*	158 W. Madison St.
OR, J. F. X.	Woodstock.	St. Francis Xavier (N. Y.)	*Shemitic Languages.*	Woodstock.
ORFF, W. R.	Baltimore.	J. H. U.	*Chemistry and Mineralogy.*	382 W. Lanvale St.
.*	Japan.	Sapporo, Japan.	*History.*	54 McCulloh St.
, J. T.	Millersburg, Ky.	Ohio Wesleyan.	*Mathematics and Physics.*	24 McCulloh St.
ER, A. G. (F)	Baltimore.	J. H. U.	*Chemistry.*	172 McCulloh St.
ER, C. S.*	Chicopee, Mass.	Amherst.	*Chemistry.*	226 Druid Hill Av.
, E. M. (F)	Boulder, Colo.	Univ. of Colorado.	*Latin.*	226 Druid Hill Av.
M. T.	Petersburg, Va.	Randolph Macon.	*Mathematics and Physics.*	156 N. Schroeder St.
INS, C. ALLEN.*	Syracuse, N. Y.		*Romance Languages.*	193 N. Calvert St.
INS, W. H., JR.	Baltimore.	J. H. U.	*Physics and Mathematics.*	207 Franklin St.
PSON, D.	Baltimore.	Univ. of Cincinnati.	*Shemitic Languages.*	205 W. Lombard St.
T, C.	Baltimore.	Univ. of Maryland.	*Chemistry.*	90 N. Fulton St.
LL, N.*	Madison, Ind.	Hanover College.	*Hist. and Pol. Science.*	Hotel Shirley.
ISS, R. W.	Washington, D. C.	Rutgers.	*Mathematics.*	126 First St.
ALL, D. R.	Annapolis.	St. John's Coll.	*Hist. and Pol. Science.*	365 N. Charles St.
SON, A. J.	Baltimore.	J. H. U.	*History (Sem.)*	192 Mulberry St.
S.	Japan.	Sapporo (Japan.)	*Hist. and Pol. Science.*	54 McCulloh St.
C. W.	Baltimore.	Univ. of Maryland.	*Political Economy.*	619 N. Gilmor St.
, W. B.	Pittsburg, Pa.	Univ. of Mich.	*History, etc.*	140 Cathedral St.
FFER, E. M.	Baltimore.	Univ. of Maryland.	*Chemistry and Biology.*	323 Lexington St.
ART, L. H.	New York City.	Coll. of City of N. Y.	*Chemistry and Physics.*	173 W. Lombard St.
ER, J. W.*	Vellore, India.	Rutgers.	*Greek.*	330 N. Eutaw St.
ON, S.	Westminster.	Trinity (N. C.)	*Chemistry.*	Westminster.
HTER, M.	Brooklyn, Ind.	Ind. Asbury.	*Latin and Greek.*	226 Druid Hill Av.
ER DE, G. E.*	Athens, Ohio.	Ohio Univ.	*Philos. and History.*	201 W. Hoffman St.
BERG, G. M. (F. by C.)	U. S. A.	Physicians and Surgeons. (N. Y.)	*Biology.*	53 McMechen St.
S, G. C., JR.	Govanstown.	J. H. U.	*Chemistry and Physics.*	Govanstown.
ER, J.*	Johnstown, N. Y.	Union.	*Biology.*	247 Linden Av.
, M. I. (F. by C.)	Ashtabula, O.	Williams.	*Philosophy.*	70 Cathedral St.
, H.	New York City.	Yale.	*Mathematics.*	143 St. Paul St.
R, F. M.*	Albion, Mich.	N. W. Univ.	*History, etc.*	201 N. Howard St.

NAME.	RESIDENCE.	FROM WHAT INSTITUTION.	PRINCIPAL SUBJECTS.	CITY ADDRESS.
Taylor, W. D.*	Montgomery, Ala.	Ala. Agric.	*Mathematics.*	19 McCulloh St.
Trail, H.*	Frederick.	Harvard.	*Chemistry.*	128 Cathedral St.
Van Vleck, F.*	Hoboken, N. J.	Stevens Inst.	*Hist. and Pol. Science.*	328 Madison Av.
Veneziani, C.*	Fiorenzuola, Italy.	Heidelberg.	*Mathematics.*	105 Saratoga St.
Wallis, S.*	New Orleans, La.	Georgetown (D. C.)	*Biology and Chemistry.*	37 St. Paul St.
Walz, W. F.	Baltimore.	J. H. U.	*Greek and Latin.*	288 E. Madison St.
Whicher, G. M.*	Hastings, Neb.	Iowa College.	*Greek.*	65 McCulloh St.
Wightman, A. C.*	Marion, S. C.	Wofford College.	*Biology.*	221 Fulton Av.
Wilhelm, L. W. (F. by C.)	Baltimore.	J. H. U.	*History.*	218 N. Arlington Av.
Wilson, W. (F)	Wilmington, N. C.	Princeton.	*Hist. and Pol. Science.*	8 McCulloh St.
Wood, J.*	Edenton, N. C.	Univ. of N. C.	*History, etc.*	201 N. Howard St.
Worthington, T. K.	Baltimore.	Haverford.	*Hist. and Pol. Science.*	209 N. Howard St.
Wright, C. B.	Akron, O.	Buchtel.	*English.*	8 McCulloh St.
Yonce, G. V.	Lutherville.	Roanoke.	*Chemistry.*	Lutherville.
Zweizig, J. H.	Reading, Pa.	Muhlenberg.	*Greek.*	162 Franklin St. (163)

UNDERGRADUATE STUDENTS.

MATRICULATES.

NAME.	RESIDENCE.	SCHOOL OR INSTRUCTOR.	ADVISER.	CITY ADDRESS.
Ames, J. S.	Faribault, Minn.	Shattuck School.	*Story.*	255 N. Carrollton Av.
Applegarth, E. C.*	Baltimore.	B. C. C.	*Martin.*	632 W. Fayette St.
Bayard, R. H.	Baltimore.	W. S. Marston.	*Adams.*	41 Cathedral St.
Campbell, J. P.	Charlestown, W. Va.	Andrew Small Academy.	*Martin.*	352 N. Eutaw St.
Coates, C. E.*	Baltimore.	Westtown School.	*Adams.*	118 Cathedral St.
Dohme, A. R. L.	Baltimore.	Friends' High School.	*Remsen.*	27 Hollins St.
Doub, A. A.	Hagerstown.	Wash. Co. High School.	*Adams.*	2 S. Greene St.
Eichelberger, W. S.	Woodberry.	B. C. C.	*Story.*	193 Argyle Av.
Fifield, J. C.	Kearney, Neb.	Phillips Acad. (Andover.)	*Adams.*	182 N. Eutaw St.
Gates, W. E.	Philadelphia.	G. Eastburn.	*Wood.*	120 Cathedral St.
Glenn, J., Jr.	Baltimore.	G. G. Carey.	*Warren.*	343 N. Eutaw St.
Gordon, B. B.	Baltimore.	H. W. Luckett.	*Remsen.*	27 Franklin St.
Gorton, W. C. L.	Baltimore.	B. C. C.	*Story.*	38 S. Ann St.
Guggenheimer, J. C.*	Baltimore.	W. S. Marston.	*Adams.*	427 Madison Av.
Harry, J. E.	Pylesville.	Md. Normal School.	*Warren.*	130 N. Eutaw St.
Hartogensis, B. H.	Baltimore.	B. C. C.	*Martin.*	10 Harrison St.
Hodges, J. S.	Baltimore.	St. Paul's School.	*Morris.*	83 Saratoga St.
Horner, J. M.	Oxford, N. C.	University of Virginia.	*Morris.*	212 W. Hoffman St.
Hough, T.	Baltimore.	W. S. Marston.	*Warren.*	181 McCulloh St.
Lamb, A. L.	Baltimore.	E. M. Lamb.	*Remsen.*	187 McCulloh St.
Loane, J. A.	Baltimore.	B. C. C.	*Morris.*	410 N. Eden St.
McLane, A., Jr.	Baltimore.	H. W. Luckett.	*Warren.*	37 Cathedral St.
McLane, R. M., Jr.*	Baltimore.	G. G. Carey.	*Warren.*	37 Cathedral St.
McPherson, J. H. T.*	Baltimore.	B. C. C.	*Warren.*	230 Madison Av.
Pleasants, J.	Baltimore.	W. S. Marston.	*Adams.*	66 Mt. Vernon Pl.
Price, H. W.	Washington, D. C.	B. C. C.	*Adams.*	Washington, D. C.
Rogers, R. W.*	Philadelphia.	Univ. of Pennsylvania.	*Morris.*	266 N. Howard St.
Ryttenberg, M. R.	Baltimore.	B. C. C.	*Adams.*	72 N. Front St.
Smith, W. F.	Baltimore.	B. C. C.	*Martin.*	45 Harlem Av.
Steiner, H.	Baltimore.	B. C. C.	*Adams.*	23 Hollins St.
Thompson, H. O.*	Baltimore.	W. S. Marston.	*Warren.*	78 Monument St.
White, E. L.*	Baltimore.	W. S. Marston.	*Martin.*	102 Boundary Av.
Wiesenfeld, B.*	Baltimore.	Harvard.	*Adams.*	111 E. Baltimore St.
Williams, J. W.*	Baltimore.	B. C. C.	*Remsen.*	201 Madison Av.
Williams, L.	Boston, Mass.	W. S. Marston.	*Adams.*	74 Cathedral St.
Williams, W. K.	Boston, Mass.	W. S. Marston.	*Adams.*	74 Cathedral St.
Wingert, H. F.	Hagerstown.	Wash. Co. High School.	*Morris.*	Baker and Gilmor Sts.
Woods, A. C.	Baltimore.	G. G. Carey.	*Adams.*	374 Eutaw Pl. (38)

STUDENTS NOT FULLY MATRICULATED.

Bromwell, W.*	Port Deposit.	West Nottingham Acad.	*Remsen.*	73 Charles St. Av.
Brune, H. M.*	Baltimore.	St. Paul's School.	*Adams.*	16 North Av.
Buckler, T. H.	Baltimore.	Harvard.	*Martin.*	135 N. Charles St.
Cole, W. R.*	Baltimore.	W. S. Marston.	*Warren.*	18 Huntingdon Av.
Crosby, P. B.*	Catonsville.	W. S. Marston.	*Remsen.*	Catonsville.
Dorsey, R.*	Baltimore.	B. C. C.	*Morris.*	205 Franklin St.
Duffy, E., Jr.*	Baltimore.	B. C. C.	*Warren.*	82 W. Townsend St.
Eareckson, E., Jr.*	Baltimore.	W. S. Marston.	*Story.*	High and Baltimore Sts.
English, H.	Washington, D. C.	Washington High School.	*Warren.*	Washington D. C.
Flexner, A.*	Louisville, Ky.	Louisville High School.	*Warren.*	216 W. Lombard St.
Friedenwald, J.*	Baltimore.	B. C. C.	*Martin.*	88 N. Eutaw St.
Gilpin, J. E.*	Baltimore.	G. G. Carey.	*Warren.*	162 N. Howard St.
Gordon, D. H.*	Baltimore.	H. W. Luckett.	*Wood.*	27 Franklin St.

NAME.	RESIDENCE.	SCHOOL OR INSTRUCTOR.	ADVISER.	CITY ADDRESS.	
Hoffman, N. O.*	New York City.	Dr. J. Sachs.	*Warren.*	266 N. Howard St.	
Hughes, P. M.*	Washington, D. C.	Dickinson.	*Morris.*	60 George St.	
Jackson, W. B.*	Marion, Va.	University of Virginia.	*Warren.*	181 Linden Av.	
Jones, W.*	Baltimore.	B. C. C.	*Warren.*	281 Maryland Av.	
Jones, W. A.*	Tuscaloosa, Ala.	C. Maupin.	*Morris.*	The Albion.	
Kaessmann, F. D. J.*	Baltimore.	W. S. Marston.	*Morris.*	47 S. Eden St.	
Laessig, J. H.	Baltimore.	Md. Coll. of Pharmacy.	*Remsen.*	419 W. Fayette St.	
Morris, H. H.*	Baltimore.	W. S. Marston.	*Morris.*	78 Charles St. Av.	
Pleasants, R. H.	Baltimore.	H. W. Luckett.	*Adams.*	40 Cathedral St.	
Roberts, D. E.	Baltimore.	Pennsylvania State Coll.	*Remsen.*	7 Tome St.	
Rowland, A. J.*	Baltimore.	Univ. of Pennsylvania.	*Wood.*	162 N. Calhoun St.	
Trower, T. L., Jr.*	Locustville, Va.	Onancock Academy.	*Story.*	180 Linden Av.	
Tuska, B. S. W.*	New York City.	Coll. City of New York.	*Adams.*	252 E. Baltimore St.	
Waltemeyer, J. T. (C)	Atchison, Kansas.	E. M. Lamb.	*Martin.*	190 Mosher St.	
Weech, R. W. H.*	Baltimore.	B. C. C.	*Adams.*	398 Madison Av.	
Winslow, J. R.	Baltimore.	Friends' School, Prov., R. I.	*Martin.*	23 McCulloh St.	
Young, F. G.*	Beaver Dam, Wis.	Wis. Normal School.	*Adams.*	201 N. Howard St.	(30)

PRELIMINARY MEDICAL.

Birney, H. H.*	Washington, D. C.	Lehigh University.	*Martin.*	209 W. Biddle St.	
Dreyer, G. P.*	Baltimore.	B. C. C.	*Martin.*	168 S. Broadway.	
Knight, H.*	Lancaster, Pa.	Lehigh University.	*Martin.*	132 W. Madison St.	
Lowndes, C. H. T. (C)*	Easton.	J. C. Kinnear.	*Martin.*	The Albion.	
O'Donovan, H.*	Baltimore.	W. S. Marston.	*Martin.*	115 W. Monument St.	
Shemwell, J. F.*	Prince Frederick.	Charlotte Hall School.	*Martin.*	52 Conway St.	
Stow, A. H. (C)	Baltimore.	B. C. C.	*Martin.*	435 N. Mount St.	
Straus, I. J.*	Baltimore.	W. S. Marston.	*Martin.*	136 N. Calhoun St.	
Willis, E. W.*	Baltimore.	B. C. C.	*Martin.*	380 E. Baltimore St.	(9)

SPECIAL STUDENTS.

Ashe, W. R.*	Wadesboro, N. C.	Bingham School.	*Remsen.*	139 N. Calvert St.	
Bevan, W. L.	Baltimore.	Rev. W. Kirkus.	*Morris.*	101 W. Lanvale St.	
Boucsein, G. F.	Baltimore.	Univ. of Md.	*Remsen.*	891 W. Pratt St.	
Brack, C. E.*	Baltimore.	E. M. Lamb.	*Adams.*	Ensor and Forrest Sts.	
Carter, J. M., Jr.*	Mt. Washington.	B. C. C.	*Story.*	Mt. Washington.	
Dashiell, P. J.*	Port Republic.	St. John's Coll.	*Remsen.*	266 N. Howard St.	
Davis, H. B.*	Baltimore.	E. M. Lamb.	*Remsen.*	Pratt and Patterson Park Av.	
Easter, D. M.	Baltimore.	Private Instruction.	*Remsen.*	470 Madison Av.	
Ensey, R. F., Jr.	St. Denis.	B. C. C.	*Story.*	St. Denis P. O.	
Ferguson, W. C.*	Richmond, Ind.	Richmond (Ind). High Sch.	*Adams.*	132 W. Madison Av.	
Hahn, H. W.*	Chicago, Ill.	Chicago High School.	*Franklin.*	288 W. Fayette St.	
Grape, J., Jr.	Baltimore.	B. C. C.	*Haupt.*	97 Hillen St.	
Jefferson, H. S.*	Baltimore.	E. M. Lamb.	*Martin.*	10 S. Broadway.	
Marks, A. H.*	Winchester, Tenn.	Univ. of the South.	*Adams.*	266 N. Howard St.	
Mason, J. C.*	Baltimore.	St. Paul's School.	*Remsen.*	169 St. Paul St.	
Mindeleff, C.*	Washington, D. C.	Washington High School.	*Remsen.*	60 George St.	
Mount, C. K.*	Baltimore.	W. S. Marston.	*Remsen.*	169 Linden Av.	
Penniman, W. B. D.	Howard Co.	B. C. C.	*Remsen.*	St. Denis P. O.	
Preston, A.*	Baltimore.	G. G. Carey.	*Gildersleeve.*	466 Eutaw Place.	
Reese, D. M.*	Baltimore.	B. C. C.	*Martin.*	495 Madison Av.	
Reeves, W. P.*	Richmond, Ind.	Earlham.	*Wood.*	135 W. Madison St.	
Roberts, B. T.	North Chili, N. Y.	Rochester University.	*Warren.*	255 N. Carrollton Av.	
Rouse, W. G.*	Belair.	Belair Academy.	*Adams.*	220 N. Carrollton Av.	
Schaefer, J.*	Baltimore.	B. C. C.	*Adams.*	382 W. Fayette St.	
Slack, H. R.	La Grange, Ga.	Md. Coll. of Pharmacy.	*Remsen.*	42 Mulberry St.	
Stein, M. D.	Oakland, Cal.	University of California.	*Remsen.*	232 Argyle Av.	
Stevens, M. P.*	Baltimore.	B. C. C.	*Rowland.*	254 Linden Av.	
Swartz, C. K.*	Gettysburg, Pa.	Pennsylvania College.	*Remsen.*	73 Edmondson Av.	
Tyson, I., Jr.*	Baltimore.	Rev. J. B. Purcell.	*Remsen.*	Charles and Lexington Sts.	
Tyson, J. W., Jr.*	Baltimore.	Haverford.	*Remsen.*	Charles and Lexington Sts.	
Van Meter, W. K.*	Rochester, N. Y.	Hamilton.	*Adams.*	1 McCulloh St.	
Wiegand, H. H.	Baltimore.	B. C. C.	*Remsen.*	272 Madison Av.	
White, J., Jr.*	Poolesville.	Charleston (W. Va.) Acad.	*Remsen.*	258 Linden Av.	
Woodward, R. H.*	Saluda, Va.	Virginia Mil. Inst.	*Hall.*	203 W. Lombard St.	(34)

HOURS FOR LECTURES AND RECITATIONS, FIRST HALF-YEAR, 1884-85.

HOURS.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
A. M. 9	General Chemistry. (Remsen.) Analyt. Chemistry. (Morse.) Latin Prose. (Spieker.) Thucydides. (C. D. Morris.) Animal Morphology. (Brooks.) Gothic. (Wood.) Elocution. (Woodworth.)	General Chemistry. (Remsen.) Analyt. Chemistry. (Morse.) Livy. (Spieker.) Analyt. Mechanics. (Newcomb.) Italian. (Todd.) Classical Antiq. (Emerson.) Problems in Mechanics. (Franklin.) Early English. (Egge.) Elocution. (Woodworth.)	General Chemistry. (Remsen.) Analyt. Chemistry. (Morse.) Latin at sight. (Spieker.) Italian. (Todd.) Animal Morphology. (Brooks.) Romance Lang.: Adv. (Elliott.) New Test. Greek. (Harris.) Anglo-Saxon: Béowulf. (Wood.) German Conversation. (Gerber.) Elocution. (Woodworth.)	General Chemistry. (Remsen.) Analyt. Chemistry. (Morse.) Livy. (Spieker.) Pedagogics. (Hall.) Analyt. Mechanics. (Newcomb.) Spanish. (Todd.) Problems in Mechanics. (Franklin.) Gothic. (Wood.) German Conversation. (Gerber.) Elocution. (Woodworth.)	General Chemistry. (Remsen.) Livy. (Spieker.) Spanish. (Todd.) Animal Morphology. (Brooks.) Classical Antiq. (Emerson.) New Test. Greek. (Harris.) Early English. (Egge.) Elocution. (Woodworth.)	
10	General Physics. (Kimball.) Physiol. and Histol. (Martin.) Electr. and Magnetism. (Rowland.) German: Major. (Hempl.) French: Major. (Todd.) Latin Prose. (C. D. Morris.) Latin Prose. (Warren.) Romance Lang.: Adv. (Elliott.) New Test. Greek. (Harris.) Math.: Intr. for Grad. (Story). Elocution. (Woodworth.)	General Physics. (Kimball.) Physiol. and Histol. (Martin.) Electr. and Magnetism. (Rowland.) German: Major. (Wood.) French: Major. (Todd.) Cicero. (C. D. Morris.) Plautus, etc. (Warren.) Greek Exercises. (Gildersleeve.) New Test. Greek. (Harris.) Math.: Intr. for Grad. (Story.) Elocution. (Woodworth.)	General Physics. (Kimball.) Mammal. Anat. (McMurrich.) Electr. and Magnetism. (Rowland). German: Major. (Wood.) French: Major. (Todd.) History of Politics. (Adams.) Latin at sight. (C. D. Morris.) Latin at sight. (Warren.) Romance Lang.: Adv. (Elliott.) New Test. Greek. (Harris.) Math.: Intr. for Grad. (Story.) Elocution. (Woodworth.)	General Physics (Kimball.) Physiol. and Histol. (Martin.) Electr. and Magnetism. (Rowland.) German: Major. (Hempl.) French: Major. (Todd.) History of Politics. (Adams.) Cicero. (C. D. Morris.) Plautus, etc. (Warren.) Assyrian. (Haupt.) New Test. Greek. (Harris.) Math.: Intr. for Grad. (Story.) Elocution. (Woodworth.)	General Physics. (Kimball.) Mammal. Anat. (McMurrich.) Electr. and Magnetism. (Rowland.) German: Major. (Wood.) French: Major. (Todd.) History of Politics. (Adams.) Cicero. (C. D. Morris.) Plautus, etc. (Warren). Greek Exercises. (Gildersleeve). New Test. Greek. (Harris.) Math.: Intr. for Grad. (Story.) Elocution. (Woodworth.)	Vedic Sanskrit. (Bloomfield.)
11	General Biology. (Martin.) German: Minor. (Hempl.) French: Minor. (Fontaine.) Church History. (Adams.) Greek Prose. (Spieker.) Romance Lang.: Adv. (Elliott.) Hydrodynamics: (Craig.) Theory of Equations. (Franklin.) Sanskrit: Elem. (Bloomfield.) Elocution. (Woodworth.)	Osteology. (McMurrich.) German: Minor. (Wood.) Latin Seminary. (Warren.) Isocrates. (Spieker.) Differential Equations. (Craig.) Shakespeare. (Browne.) Elocution. (Woodworth.)	General Biology. (Martin.) German: Minor. (Hempl.) Isocrates. (Spieker.) Romance Lang.: Adv. (Elliott). Hydrodynamics. (Craig.) Theory of Equations. (Franklin.) English & French Hist. (Jameson.) Elocution. (Woodworth.)	Osteology. (McMurrich.) German: Minor. (Hempl.) Church History. (Adams.) Roman Satirists. (Warren.) Isocrates. (Spieker.) Assyrian. (Haupt.) Differential Equations. (Craig.) New Test. Greek. (Harris.) English & French Hist. (Jameson.) Elocution. (Woodworth.)	General Biology. (Martin.) German: Minor. (Wood.) Latin Seminary. (Warren.) Isocrates. (Spieker.) Hydrodynamics. (Craig.) Theory of Equations. (Franklin.) Shakespeare. (Browne.) English & French Hist. (Jameson.) Elocution. (Woodworth.)	
M. 12	Greek Seminary. (Gildersleeve.) Psychology. (Hall.) Greek Prose. (C. D. Morris.) Modern Synthet. Geom. (Story.) International Law. (Adams.) Romance Lang.: Adv. (Elliott.) Geology. (Williams.) History: P. H. E. (Jameson.) German Conversation. (Gerber.) Elocution. (Woodworth.)	Psychology (Hall.) French: Minor. (Bowen.) Plato. (C. D. Morris.) Theory of Numbers. (Story.) International Law. (Adams.) Geology. (Williams.) History: P. H. E. (Jameson.) German Conversation. (Gerber.) Elocution. (Woodworth.)	Greek Seminary. (Gildersleeve.) French: Minor. (Todd.) Plato. (C. D. Morris.) Modern Synthet. Geom. (Story.) Polit. Econ.: Adv. (Ely.) English Constitution. (Jameson.) English Lit.: P. H. E. (Browne.) Old High German. (Wood.) Elocution. (Woodworth.)	Dionysios. (Gildersleeve.) French: Minor. (Todd.) Plato. (C. D. Morris.) Theory of Numbers. (Story.) Polit. Econ.: Adv. (Ely.) English Constitution (Jameson.) Geology. (Williams.) English Lit.: P. H. E. (Browne.) Middle High German. (Wood.) Elocution (Woodworth.)	French: Minor. (Bowen.) Plato. (C. D. Morris.) Modern Synthet. Geom. (Story.) Polit. Econ.: Adv. (Ely.) English Constitution. (Jameson.) Sanskrit: Elem. (Bloomfield.) History: P. H. E. (Adams.) German Conversation. (Gerber.) Elocution. (Woodworth.)	
P. M. 1	Polit. Econ.: Elem. (Ely.) Italian. (Todd.) Theory of Functions. (Craig.) Calculus. (Franklin.) Drawing. (Newell.) Elocution. (Woodworth.)	Polit. Econ.: Elem. (Ely.) Romance Lang.: Adv. (Elliott.) Calculus of Variations. (Craig.) Conic Sections. (Story.) Drawing. (Newell.) Elocution. (Woodworth.)	Polit. Econ.: Elem. (Ely.) Romance Lang.: Adv. (Todd.) Theory of Functions. (Craig.) Calculus. (Franklin.) Elocution. (Woodworth.)	Polit. Econ.: Elem. (Ely.) Romance Lang.: Adv. (Todd.) Calculus of Variations. (Craig.) Conic Sections. (Story.) Drawing. (Newell.) Elocution. (Woodworth.)	Polit. Econ.: Elem. (Ely.) Romance Lang.: Adv. (Todd.) Theory of Functions. (Craig.) Calculus. (Franklin.) Drawing. (Newell.) Elocution. (Woodworth.)	Drawing. (Newell.)
2	Drawing. (Newell.) Latin. (Slaughter.)	Drawing. (Newell.) Greek. (C. D. Morris.)	Latin. (Slaughter.)	Drawing. (Newell.) Greek. (C. D. Morris.)	Mineralogy. (Williams.) Drawing. (Newell.) Latin. (Slaughter.)	Drawing. (Newell.)
3	French Conversation. (Fontaine.) Goethe: Prosa. (Hempl.) French: Elem. (Bowen.) Drawing. (Newell.)	Arabic. (Haupt.) French Conversation. (Fontaine.) German: Elem. (Hempl.) Drawing. (Newell.)	Hebrew Exercises. (Haupt) French Conversation. (Fontaine.) Goethe: Prosa. (Hempl.) French: Elem. Bowen.)	Assyrian. (Haupt.) French Conversation. (Fontaine.) German: Elem. (Hempl.) Drawing. (Newell.)	French Conversation. (Fontaine.) Mineralogy (Williams.) German: Elem. (Hempl.) (Alternate Fridays.) French: Elem. (Bowen.) (Alternate Fridays.) Drawing. (Newell.)	Drawing. (Newell.)
4	Hebrew: Elem. (Haupt.) Comp. Gram. of Greek. (Bloomfield.) Ethics. (G. S. Morris.) Trigonometry. (Franklin.) Calculus. (Nixon.) Drawing. (Newell.) German: Elem. (Hempl.) German Style. (Wood.) (Monthly.)	Psalms. (Haupt.) Anglo-Saxon. (Wright.) History of Philos. (G. S. Morris.) Analytic Geometry. (Franklin.) Calculus. (Nixon.) Drawing (Newell.) German: Elem. (Hempl.) (Alternate Tuesdays.)	Math. Seminary. (Story.) Chaldee. (Haupt.) Comp. Philol. (Bloomfield.) Philos. of State. (G. S. Morris.) Trigonometry. (Franklin.) Calculus. (Nixon.)	Physics: Major. (Kimball.) Ethiopic. (Haupt.) Hist. of Philos. (G. S. Morris.) Analytic Geometry. (Franklin.) Calculus. (Nixon.) Drawing. (Newell.) German: Elem. (Hempl.)	Math. Seminary. (Craig.) Hebrew: Elem. (Haupt.) Anglo-Saxon. (Wright.) Mineralogy. (Williams.) Ethics. (G. S. Morris.) Trigonometry. (Franklin.) Calculus. (Nixon.) Drawing. (Newell.)	Drawing. (Newell.)

The public lectures begin in Hopkins Hall at 8 p. m.

NAME.	RESIDENCE.	FROM WHAT INSTITUTION.	PRINCIPAL SUBJECTS.	CITY ADDRESS.
Hathaway, A. S. (F. by C.)	Decatur, Mich.	Cornell.	*Mathematics.*	201 N. Howard St.
Hayes, C. W.*	Hanover, O.	Oberlin.	*Chemistry.*	203 N. Howard St.
Haynes, E.*	Portland, Ind.	Worcester Free Inst.	*Biology and Chemistry.*	106 N. Eutaw St.
Hemmeter J. C.*	Baltimore.	Univ. of Maryland.	*Biology and Chemistry.*	204 German St.
Herrick, F. H.*	Tilton, N. H.	Dartmouth.	*Biology.*	16 McCulloh St.
Hillyer, H. W. (F)	Waupun, Wis.	Univ. of Wisconsin.	*Chemistry.*	283 Park Av.
Hitchcock, G. G.*	Lincoln, Neb.	Univ. of Nebraska.	*Physics and Chemistry.*	333 N. Eutaw St.
Hobbs, W. H.*	Auburn, Mass.	Worcester Free Inst.	*Chemistry and Physics.*	266 N. Howard St.
Hogg, W. S.*	Washington, D. C.	U. S. Naval Acad.	*Physics and Chemistry.*	Washington, D. C.
Holcomb, W. P.	Newtown, Pa.	Swarthmore.	*Hist. and Pol. Science.*	48 McCulloh St.
Howard, C. H.	Baltimore.	J. H. U.	*History and German.*	101 N. Charles St.
Hubbard, F. G.*	Oswego, N. Y.	Williams.	*English.*	118 W. Biddle St.
Huizinga, A. H. (F)	Zeeland, Mich.	Hope College.	*Shemitic Languages.*	70 Cathedral St.
Hussey, G. B.*	E. Orange, N. J.	Columbia.	*Greek.*	24 McCulloh St.
Jastrow, J.	Philadelphia.	Univ. of Pa.	*Psychology and Logic.*	256 W. Lombard St.
Johnson, J.	Baltimore Co.	J. H. U.	*History (Sem.)*	McDonogh P. O.
Kastle, J. H.*	Lexington, Ky.	Ky. State College.	*Chemistry and Biology.*	330 N. Eutaw St.
Keilholtz, P. O.*	Baltimore.	U. S. Naval Acad.	*Physics.*	356 N. Charles St.
Kemp, G. T.	Baltimore.	J. H. U.	*Biology.*	55 N. Green St.
Lambert, M. B.*	Riegelsville, Pa.	Lafayette.	*Mathematics and Physics.*	147 Mulberry St.
Learned, M. D.*	Dover, Del.	Dickinson.	*Modern Languages.*	247 Linden Av.
Lee, F. S. (F)	Canton, N. Y.	St. Lawrence Univ.	*Biology.*	122 Cathedral St.
Lerch, C. H.*	Easton, Pa.	Lafayette.	*English.*	24 McCulloh St.
Levermore, C. H. (F)	New Haven, Conn.	Yale.	*Hist. and Pol. Science.*	330 Maryland Av.
Lewis, H. C.* (F. by C.)	Germantown, Pa.	Univ. of Pa.	*Mineralogy.*	St. James Hotel.
Lichty, W. H.*	Lincoln, Neb.	Univ. of Nebraska.	*Hist. and Pol. Science.*	130 N. Eutaw St.
Liebig, G. A., Jr. (F)	Baltimore.	J. H. U.	*Physics.*	307 St. Paul St.
Lodge, G.	Baltimore.	J. H. U.	*Greek and Latin.*	445 N. Mount St.
Love, J. L.*	Gastonia, N. C.	Univ. of N. C.	*Mathematics and Physics.*	201 N. Howard St.
Lowry, W. S.*	Smithville, Va.	S. C. Theol. Sem.	*Greek, German, etc.*	129 Bolton St.
MacGoldrick, D. J.*	Woodstock.	[Woodstock College].	*Biology.*	Loyola College.
Mansfield, J. M.*	Mt. Pleasant, Iowa.	Iowa Wesleyan.	*Mathematics and Physics.*	160 Druid Hill Av.
Matzke, J. E.*	Baileyville, Ill.	Hope Coll.	*Modern Languages.*	134 N. Eutaw St.
McClintock, C. T.	Millersburg, Ky.	Ky. Wesleyan.	*Biology, etc.*	330 N. Eutaw St.
McCulloch, J. F.*	Pleasant Garden, N. C.	Adrian Coll.	*Mathematics.*	19 McCulloh St.
McDaniel, W. R.	St. Michael's.	Western Maryland.	*Mathematics.*	367 Eutaw Place.
McIntosh, J. H.*	Newberry, S. C.	Newberry.	*Chemistry and Biology.*	330 N. Eutaw St.
McMahon, R. F.*	Cambridge, O.	Princeton.	*History, etc.*	209 N. Howard St.
McMurrich, J. P.*	Toronto, Canada.	Univ. of Toronto.	*Biology.*	181 Linden Av.
Metzler, G. F.*	Odessa, Canada.	Albert College.	*Mathematics.*	63 St. Paul St.
Miller, C. W. E. (F)	Baltimore.	J. H. U.	*Greek.*	306 S. Sharp St.
Miller, E. G., Jr.	Baltimore.	J. H. U.	*Hist. and Pol. Science.*	279 W. Baltimore St.
Morrill, P.	Loudon, N. H.	Amherst.	*Physics.*	47 Courtland St.
Morris, C. N.*	West Hartford, Ct.	Yale.	*Hist. and Pol. Science.*	20 Cathedral St.
Nachtrieb, H. F. (F)	St. Paul, Minn.	Univ. of Minn.	*Biology.*	213 W. Biddle St.
Nelson, J.	Waupaca, Wis.	Univ. of Wisconsin.	*Biology.*	134 N. Eutaw St.
Newman, J.*	Osco, Ill.		*Shemitic Languages.*	Darlington.
Newton, J. C.*	Millersburg, Ky.	Ky. Mil. Inst.	*Philosophy and Pedagogy.*	69 Preston St.
Nixon, H. B. (F)	Winfall, N. C.	Univ. of N. C.	*Mathematics and Physics.*	212 W. Hoffman St.
Noyes, W., Jr.* (F)	Malden, Mass.	Harvard.	*Psychology.*	158 W. Madison St.
O'Conor, J. F. X.	Woodstock.	St. Francis Xavier (N. Y.)	*Shemitic Languages.*	Woodstock.
Orndorff, W. R.	Baltimore.	J. H. U.	*Chemistry and Mineralogy.*	382 W. Lanvale St.
Ota, I.*	Japan.	Sapporo, Japan.	*History.*	54 McCulloh St.
Outen, J. T.	Millersburg, Ky.	Ohio Wesleyan.	*Mathematics and Physics.*	24 McCulloh St.
Palmer, A. G. (F)	Baltimore.	J. H. U.	*Chemistry.*	172 McCulloh St.
Palmer, C. S.*	Chicopee, Mass.	Amherst.	*Chemistry.*	226 Druid Hill Av.
Pease, E. M. (F)	Boulder, Colo.	Univ. of Colorado.	*Latin.*	226 Druid Hill Av.
Peed, M. T.	Petersburg, Va.	Randolph Macon.	*Mathematics and Physics.*	156 N. Schroeder St.
Perkins, C. Allen.*	Syracuse, N. Y.		*Romance Languages.*	193 N. Calvert St.
Perkins, W. H., Jr.	Baltimore.	J. H. U.	*Physics and Mathematics.*	207 Franklin St.
Philipson, D.	Baltimore.	Univ. of Cincinnati.	*Shemitic Languages.*	205 W. Lombard St.
Piggot, C.	Baltimore.	Univ. of Maryland.	*Chemistry.*	90 N. Fulton St.
Powell, N.*	Madison, Ind.	Hanover College.	*Hist. and Pol. Science.*	Hotel Shirley.
Prentiss, R. W.	Washington, D. C.	Rutgers.	*Mathematics.*	126 First St.
Randall, D. R.	Annapolis.	St. John's Coll.	*Hist. and Pol. Science.*	365 N. Charles St.
Robinson, A. J.	Baltimore.	J. H. U.	*History (Sem.)*	192 Mulberry St.
Sato, S.	Japan.	Sapporo (Japan.)	*Hist. and Pol. Science.*	54 McCulloh St.
Sams, C. W.	Baltimore.	Univ. of Maryland.	*Political Economy.*	619 N. Gilmor St.
Scaife, W. B.	Pittsburg, Pa.	Univ. of Mich.	*History, etc.*	140 Cathedral St.
Schaeffer, E. M.	Baltimore.	Univ. of Maryland.	*Chemistry and Biology.*	323 Lexington St.
Schubart, L. H.	New York City.	Coll. of City of N. Y.	*Chemistry and Physics.*	173 W. Lombard St.
Scudder, J. W.*	Vellore, India.	Rutgers.	*Greek.*	330 N. Eutaw St.
Simpson, S.	Westminster.	Trinity (N. C.)	*Chemistry.*	Westminster.
Slaughter, M.	Brooklyn, Ind.	Ind. Asbury.	*Latin and Greek.*	226 Druid Hill Av.
Steiguer de, G. E.*	Athens, Ohio.	Ohio Univ.	*Philos. and History.*	201 W. Hoffman St.
Sternberg, G. M. (F. by C.)	U. S. A.	Physicians and Surgeons. (N. Y.)	*Biology.*	53 McMechen St.
Stokes, G. C., Jr.	Govanstown.	J. H. U.	*Chemistry and Physics.*	Govanstown.
Stoller, J.*	Johnstown, N. Y.	Union.	*Biology.*	247 Linden Av.
Swift, M. I. (F. by C.)	Ashtabula, O.	Williams.	*Philosophy.*	70 Cathedral St.
Taber, H.	New York City.	Yale.	*Mathematics.*	143 St. Paul St.
Taylor, F. M.*	Albion, Mich.	N. W. Univ.	*History, etc.*	201 N. Howard St.

CHESAPEAKE ZOÖLOGICAL LABORATORY.

REPORT OF THE DIRECTOR FOR THE YEAR 1884.

[Reprinted from the Ninth Annual Report of the Johns Hopkins University].

To the President of the Johns Hopkins University:

SIR: I take pleasure in handing to you, at your request, the report of the seventh annual session of the marine laboratory of the University.

The laboratory was open for research, at Beaufort, North Carolina, from June 1st to September 19th, and its facilities were used by the following naturalists:

W. K. BROOKS, *Director.*
H. W. Conn, *Assistant in charge.*
E. A. Andrews, *Fellow J. H. U.*
Wm. Bateson, *University of Cambridge, England.*
H. H. Donaldson, *J. H. U.*
E. A. Hartwell, *Teacher, Fitchburg, Mass.*
G. F. Kemp, *J. H. U.*
J. Nelson, *J. H. U.*
H. F. Nachtrieb, *Fellow J. H. U.*
H. L. Osborn, *Instructor in Zoölogy, Purdue University, Lafayette, Ind.*

Owing to the illness of the director he was able to spend only one month at the laboratory, and it was, for two months, in charge of H. W. Conn, Ph. D., Professor of Zoölogy at the Wesleyan University, Middletown, Conn.

Our experiment, of a year since, in the Chesapeake Bay, has demonstrated that Beaufort is the best available locality for our work, and our outfit was accordingly moved back from Hampton to Beaufort, in June, and the house which we had occupied in 1880–81 and '82 was again rented for occupation as a laboratory. The expenses of removal, together with the illness of the director, compelled us to make our season much shorter than usual, and the laboratory was occupied for only fifteen weeks.

The building at Beaufort furnishes accommodations for only six persons, and as our party of ten crowded it so much as to hamper our work I was compelled to refuse several applicants.

The following subjects among others were studied by the members of the party: The embryology of Echinoderms; the systematic zoölogy and anatomy and embryology of Annelids; the embryology of Medusae.

Dr. Conn has completed his work on the development of Thalassema, and his paper is ready for publication. He has also made many additions to a subject upon which he has been engaged for three years past,—a monograph upon the Crabs of Beaufort. This work is now nearly completed and ready for publication, and will form a large volume with about twenty-five quarto plates. He has also studied the development of Serpula, and an abstract of his observations is now in press. The most important points are that the blastopore elongates and closes in such a manner that one extremity becomes the mouth and the other the anus, while the closed lips form the ventral surface. Mr. Conn has also prepared a paper on larval forms, which is to appear in the *Studies from the Biological Laboratory.*

Dr. Donaldson was occupied for three months in the study of the physiology of marine invertebrates. He made many experiments to determine the relative susceptibility of the different classes of invertebrates to poisons of vegetable origin. He also carried on a series of experiments to determine whether the current theory of digestion in the Actinozoa is correct. These experiments failed to support the theory.

The results of Mr. Bateson's work upon Balanoglossus last year, were published in England last winter, and were regarded as of such importance that a grant of money was given by the Royal Society, to enable him to return to Beaufort this season and complete them. His more recent researches seem to show that Balanoglossus presents many features of relationship to the Echinoderms and also many points of resemblance to the Vertebrates. An abstract of his conclusions was read at the Montreal meeting of the British Association.

Dr. Osborn has studied the embryology of Fulgur and Neptunia, and a short abstract of his results is now in press. A longer illustrated paper will be ready for publication this winter. His results show that the gill of Neptunia arises as a series of perfectly simple folds, upon the *outer surface* of the animal, and before the mantle cavity is formed, and as the mantle cavity is formed these folds are carried into it. He believes that this is the primitive condition of the gills of Gasteropods, and that the formation of a "ctenidium" is secondary. He has also studied the origin of the body cavity and reproductive organs of Gasteropods.

The early stages of Teleosts, and of Limulus have also been studied.

I have made many additions to my notes on the Medusae of Beaufort, and my monograph upon this subject, upon which I have been engaged for five years, is now sufficiently advanced for publication, as soon as a publisher can be found. It will form a large volume, with about thirty quarto plates.

I have now in press an abstract of my observations, made this summer upon the embryology of Eutimia. The following are some of the more important points. Delamination takes place over the whole inner surface of the blastoderm, and the digestive cavity is not obliterated. After the endoderm has been formed, the ectoderm becomes deeply invaginated, to form the adhesive gland of the planula. The planula does not become converted into a hydranth, but becomes a root, from which hydranths are formed by budding.

An illustrated paper upon the embryology of Eutimia and Liriope is now in preparation for the *Studies from the Biological Laboratory*, and it will be ready for publication this winter.

I was also able this summer to make a few observations upon the metamorphosis of Stomatopods, and these will be incorporated in my report on the Stomatopods of the Challenger Expedition, which will be ready for the press in March, 1885.

I have also in preparation, a paper, based on observations made this summer, on the origin of alternation in hydroids. This will be ready for publication in the *Studies* this winter, and I shall give facts which I believe to show that in this group, alternation has not originated through polymorphism, or division of labor, but through the asexual multiplication of immature larvae.

The following papers, based upon researches which are carried on at the marine laboratory have appeared since my last report, and five or six other papers are now in press, and will appear immediately.

On the Gill in some forms of Prosobranchiate Molluscs, by H. L. Osborn. *Studies from the Biological Laboratory*, vol. iii, no. 1, with three plates.

Life History of Thalassema, (abstract), by H. W. Conn. *Studies from the Biological Laboratory*, vol. iii, no. 1, with one plate.

The Significance of the Larval Skin of Decapods, by H. W. Conn. *Studies from the Biological Laboratory*, vol. iii, no. 1, with two plates.

On the Osteology of Syngnathus Peckeanus, by J. P. McMurrich. *University Circulars*, iii, 27.

An Instance of Sexual Variation in Crustacea, by H. W. Conn. *University Circulars*, iii, 27.

Abstract of Observations on the Development of Balanoglossus, by Wm. Bateson. *University Circulars*, iii, 27.

On the Osteology and Development of Syngnathus Peckeanus, by J. Playfair McMurrich. *Quart. Journ. Mic. Sc.*, vol. 23, (*October*,) 623–650, with two plates.

Upon the Ears of Fishes, with reference to the Function of Equilibrium, by H. Sewall. *Journal of Physiology*, iv, 339.

The Early Stages in the Development of Balanoglossus, by Wm. Bateson. *Quart. Journ. Mic. Science*, no. xciv, 208, with four plates.

Dr. H. J. Rice, a former Fellow of the University, writes that he has, in a pond at Cold Spring Harbor, a fine set of young oysters, which he has reared from the egg by methods which were first made known at the laboratory.

Respectfully,
W. K. BROOKS,
Director, Chesapeake Zoölogical Laboratory.

BALTIMORE, *November*, 1884.

RECENT WORK IN BIOLOGY: MORPHOLOGICAL NOTES, 1884.

On a New Law of Variation. By W. K. BROOKS.

Dr. Düsing in his interesting and highly suggestive papers on the laws which regulate sex (Jenaische Zeitschrift, XVI and XVII), has given many proofs that among mankind, in other animals and in plants, a favorable environment causes an increase in the number of births of female children, while an unfavorable environment causes an increase in the number of male births.

His evidence seems to prove that we must accept his conclusion as a scientific generalization, and every one will recognize its very great value.

I wish however to say a few words regarding its significance, for I believe that it is only a part of a still wider generalization, and that its true meaning can be seen only when it is viewed as a part of a still more fundamental natural law.

If while living under favorable conditions of life, a species is able to prosper and multiply with few males, or even in the case of many animals and plants, with no males at all, multiplying by parthenogenesis or by asexual reproduction; why should males become necessary when the environment becomes unfavorable?

I believe that we have, in this fact which is so well brought out in Düsing's papers, an adjustment, which has been evolved by natural selection, for the purpose of securing variation when it is needed.

I have attempted to show, from another sort of evidence, that the two sexual elements have, by division of labor, acquired, in all the higher plants, and in most of the metazoa, specialized functions; and that the male cell causes variation, while the ovum transmits the hereditary characteristics of the species.

My reasons for this conclusion, are briefly as follows:

1. The homology between the ovum and the male cell is no reason for believing that their functions are now alike, for it only shows that they were alike at some time in the past.

2. The possibility of parthenogenesis shows that the ovum can transmit all the established characteristics of the species.

3. The study of reciprocal crosses shows that the ovum and the male cell do not have the same influence, and gives many reasons for believing that the ovum transmits established characteristics, while the male cell transmits more recent modifications.

4. When a female hybrid is crossed with the male of either one of the pure parent forms, the children are less variable than those which are born from a pure female crossed with a male hybrid.

5. Organisms born from fertilized eggs or seeds are very much more variable than those which are produced asexually, and the parthenogenetic bees are the least variable of domesticated animals.

6. A variation which first appears in a male is much more likely to become hereditary than one which first appears in a female.

7. Organs which are confined to males, or which are of more functional importance in males than in females, are very much more variable than organs which are confined to females, or organs which are of more functional importance in females than in males.

8. Throughout the whole animal kingdom, with very few exceptions, we find, wherever the sexes are separate and different from each other, the males of allied species differ more from each other than the females do, and the adult male differs from the young more than the female does.

9. We also find that males are more variable than females, and that the male leads and the female follows, in the evolution of new species. This cannot be due to sexual selection, for it holds true, to a remarkable degree, in domestic pigeons, which are paired by the breeder, and are not selected, as fowls are, for the sake of any sexual peculiarity.

I believe that it is shown by these facts, and by many others, that the function of the ovum is to transmit the characteristics of the species, and to hold on to what has been acquired in the past; that the union of two sexual elements has been evolved for the purpose of securing variability; and that the male element has gradually acquired, by division of labor, the peculiar function of exciting variability to meet changes in the condition of life.

Now it is plain that, so long as the conditions of life remain favorable there is no need for variation, but whenever any unfavorable change takes place variation becomes necessary in order to restore the harmony between the organism and its environment.

If my view is true, we have in Düsing's results, an exemplification of the action of one of the most grand and beautiful and far-reaching of all the adjustments which have ever been discovered in nature; an adaptation by means of which each organism remains unchanged so long as no change is needed, while it begins to vary whenever variation and race modification are called for.

The excess of male births among captive birds of prey and carnivorous mammals, and in uncivilized human races, which have been suddenly thrown into contact with the civilization which has been the growth of thousands of years in Europe, is to be regarded as the last effort of nature to produces a modification which shall fit them for their new surrounding.

It is true that Düsing himself gives a different explanation, and says that the excess of male births, under unfavorable conditions is for the purpose of preventing close inter-breeding. This is no doubt true, but I believe that it is only a part of the truth.

He says that inter-breeding causes decreased fertility, small size, and general loss of vitality and vigor, and that the purpose of crossing is to prevent this. He shows that the evil effects are greatest when the environment is unfavorable, and that a very favorable environment may entirely overbalance them. Crossing is therefore most necessary and important when the conditions of life are least favorable, and least important when they are most favorable, and an organism may, under a very favorable environment, multiply asexually or by parthenogenesis for an indefinite number of generations, although males and fertilized eggs appear as soon as the season of prosperity comes to an end.

This is all true, but we must remember that an injurious quality cannot be evolved by natural selection, and that the injurious effects of inter-breeding cannot be primary. The property which has been evolved is the usefulness of crossing, and the injurious effects of inter-breeding are secondary.

Now why should crossing be more advantageous under an unfavorable than under a favorable environment? Clearly because crossing gives variability, and because variation is not advantageous when everything else is favorable, while it is advantageous when other things are unfavorable.

If two species or varieties are living under the same unfavorable conditions of life, and the crossed offspring are the most vigorous and fertile in the one, while the children of closely related parents are most fertile in the other, the establishment of a hereditary favorable variation will be much more probable in the first than in the second, and the chances are that the first will ultimately exterminate the second. If, however, the conditions of life are favorable and no variation is needed, the products of a cross will have no advantage, and will not be thus selected.

Again, it is for the advantage of the species that all the individuals shall be vigorous and fertile, unless there is some especial reason why some of them should be weak and infertile. When the conditions of life are favorable, there is no such reason, and all are alike fertile; but when the conditions become unfavorable, variation is needful; and it is therefore advantageous, to species as a whole, that those individuals in which there is most chance of variation,—those born from a cross—shall be most healthful and prolific; and those where least variation can be expected, least prolific.

Hence we find that, where the conditions of life are very favorable, the children of closely related parents, or those with only one parent, or those born asexually, are as strong and prolific as those born from widely different parents; and we also find that males are scarce, or even absent.

When the conditions of life are unfavorable, blood relations become infertile, an excess of males is produced, and the children of a cross are peculiarly prolific.

Method of Formation of Trochosphere in Serpula.

By H. W. CONN.

Very few of the Annelids have a development which seems to be primitive. A great majority show undoubted evidence of a great modification in their embryology, so great as usually to give no evidence of the history of the group. There are a few, however, which for some reason have escaped this modifying influence, and still give us indications of their early history. Among these is Serpula. The development of Serpula has hitherto been studied by a single naturalist, Stossich, who published an account in 1878, so peculiar in some respects as to cause it to be held in question. Although his results have been incorporated into text books, it has yet remained desirable to investigate the matter further. On two points, in particular, have the results of Stossich been questioned. He described a regular complete segmentation, a type nowhere else found among the Annelids. (It has since been observed in several forms). But the most peculiar point according to the work of Stossich, was the history of the blastopore, which is stated to become the anus. In some animals it is true that this undoubtedly occurs, but in no other Annelid is it known, and this history in Serpula, whose history is known to be primitive, is highly remarkable.

During the last summer I have been able, with the assistance of Mr. Andrews, to investigate these and many other points with very interesting results. In the main Stossich is right. The segmentation is regular and complete, and in most of the other minor points the work this summer confirmed the previous results. But the history of the blastopore is very different from that described by Stossich, and is in brief as follows. A regular segmentation is followed by a typical invagination, giving rise to a gastrula. A band of cilia now makes its appearance around the blastopore and a tuft of sensory cilia at the opposite end. Now that part of the body within the circumblastoporal ciliated ring, and therefore containing the blastopore, begins to elongate obliquely, causing an elongation of the blastopore. The axis of this elongation does not fall through the centre of the blastopore, but through one edge of it, and the elongation is therefore such that one end of the elongated blastopore remains near the ring of cilia while the other is carried away at the end of the elongated portion of the body. As this elongation progresses the blastopore, which has become drawn out into a long slit, closes, and its lips fusing together become what proves to be the ventral median line of the full grown larva. The endoderm is entirely within the body cavity, connected with the ectoderm, however, throughout the whole extent of the closed blastopore. Soon the two extremities of this closed blastopore open again, the one near the ciliated band becoming the mouth, the other eventually becoming the anus, while the endoderm between these two points loses all connection with the ectoderm, except at the mouth and anus, and becomes hollowed out to form the alimentary canal. The blastopore is not, therefore, converted into the anus as Stossich asserts, but it elongates, one extremity eventually becoming the mouth, the other the anus, while the intermediate portion closes to form the median ventral line of the larva and full grown adult.

This result is very significant. In the first place it is an important corroboration of the far-reaching theory of Adam Sedgwick as to the primitive history of the blastopore, with which it agrees in nearly every particular. To myself it was particularly interesting because it formed the final link in a chain of evidence as to what appears to me to be the true relation of larvae to each other and to adults. I have already indicated (*University Circular No.* 22), partially, the conclusions to which I have been led by the study of Thalassema, and this result in the case of Serpula, together with much other evidence which I have been able to collect, has led me to the formation of a new theory as to the relations of larvae, an account of which is to appear in the next number of the "Biological Studies." In brief it is as follows:

As a simplest type of larva, and the most universal is found a form which agrees in essential respects with the young pilidium of Nemertians. It consists of a gastrula with a circumblastoporal band of differentiated tissue usually bearing cilia and with a tuft of cilia at the extremity opposite the blastopore mouth. It is in fact just such a gastrula as we have seen in Serpula. This type is found very widely distributed, being present in Coelenterata, Polyzoa, Brachiopoda, Vermes and Mollusks, and in a slightly modified form, *i. e.*, without the circumblastoporal ring, in Echinoderms. This form is therefore taken as a starting point and a comparison is instituted between the methods by which this larva is developed into the full grown larva and the adult in the different forms. Leaving aside the Echinoderms, which for certain reasons are classed with the vertebrates and Balanoglossus, it is found that the above mentioned groups of animals are divided into two radically distinct classes. In the first class the body of the larva and the adult is formed by the elongation of that part of the gastrula body situated *in front* of the circumblastoporal ring, between it and the anterior ciliated tuft. The Coelenterata, Polyzoa, and Brachiopoda conform to this type. To produce the adult Coelenterata the larval type attaches itself by its anterior end, the body elongates, the circumblastoporal ring grows out into tentacles and the blastopore remains as the mouth. The Polyzoa have a like history, except that the two extremities of the blastopore are separated into mouth and anus. The Brachiopoda are a still more modified form.

In the second class the body of the larva and the adult is formed by the elongation of that part of the gastrula body situated *behind* or within the circumblastoporal ring. The Mollusks and Annelids and probably other worms conform to this type. The development of Serpula as above described illustrates how this elongation takes place and an essentially similar history is found in other primitive Annelids (Thalassema and Polygordius). In Mollusks the same general change is seen, the body elongating in the same direction and the blastopore closing to form the ventral surface. In Mollusks, however, the ventral surface grows out to form the foot, the dorsal surface develops a shell, while the whole animal remains relatively short and the resulting form is very different from the Annelid, although they originally arise from the same larva by the same modification.

Gill in Neptunea. By H. L. Osborn.

Some facts observed in studying the development of a species of Neptunea abundant at Beaufort, N. C., are of interest in connection with a study of the gastropod Gill which I presented in the *Circular* for July last. A brief recapitulation of the main features of the development will conduce to clearness. The head, foot and vela arise as ectodermal thickenings upon one end of the oval egg and soon upon one side, thereby designated as dorsal and opposite to the foot, the shell gland appears. The shell gland, at first a small ring, increases in size and its rims spreads over the yolk at the end opposite the head, vela and foot until it has covered half the egg, but the area immediately around the head, vela and foot is still unencroached upon. This area is in part the region of the future mantle, and just in front of the margin of the shell area it forms a thickened ridge. This mantle area is now broadly convex as though greatly bulged out upon the dorsal surface of the body. Upon its surface there appears a row of finger-like processes, these being mere folds or thickenings of the surface which form an interrupted ridge running antero-posteriorly upon the dorsal surface of the body. Later this dorsal surface begins to roll inward by an involution which begins near the head, and the mantle cavity is thus formed with the gill which has been carried along during the involution lying upon its roof. We have thus here the formation of a gastropod gill reduced to its simplest terms, namely, a series of dilatations upon the outer surface of the body. I do not know that it has ever been pointed out that the gills arise in any prosobranch before the mantle cavity is formed, but this mode of the formation of a mantle cavity is not unique, for Rabl has described much the same sort of thing in Planorbis. This mode of the formation of the prosobranch gill on the surface of the body and its infolding with the mantle cavity is flatly opposed to the conjecture of Spengel that the prosobranch gill is a *ctenidium* which has secondarily became fused with the wall of the mantle cavity, and bears out the view which I proposed in my previous paper.

Some Observations opposed to the Presence of a Parenchymatous or Intra-cellular Digestion in Salpa.

By C. S. Dolley.

Dr. A. Korotneff has described (*Zeit. f. Wiss. Zoöl.*, XL, 1, 1884) a huge amoeboid cell or plasmodium, which he figures as occupying the oesophagus and stomach of Salpa. He regards it as a rhizopod-like digestive organ, into the protoplasmic substance of which food is directly ingested, and he concludes that we have in Salpa (and in Anchinia) a true parenchymatous digestion, and he therefore questions the high genetic position of the Tunicates.

I have made a number of series of sections for the purpose of finding this body, and while it is true that these bear a very close resemblance to those figured by Korotneff, I feel confident that he has utterly mistaken their significance. I was able to trace the so-called plasmodium not only through the oesophagus and stomach, but also through the oesophagus into the branchial sac, and through the intestine into the cloaca, and have been able to show clearly that, instead of an amoeboid cell, it is actually the mucous excretion from the endostyle, with its entangled particles of food.

In studying a series of transverse sections of a Salpa which was well fed, we find, as we approach the oesophagus, a mass of material answering to the description and figures of Korotneff's rhizopod. It takes staining readily, and may be traced backwards into and through the oesophagus, stomach and intestine. As the sections approach the rectum, however, the mass gradually ceases to take staining, and is much more distinctly marked out from the intestinal wall, having had all the organic matter digested out, and consisting only of the inorganic remains which do not stain.

In the fore part of the intestinal canal the mass contains great numbers of food-organisms, such as radiolarians, foramenifera, minute crustacea, and microscopic vegetable organisms, and it takes staining almost as readily as the walls of the gut itself, seeming to merge into the illy-defined epithelium of the latter, and it is scarcely possible to say where the food-bearing mucous thread ceases and the intestinal epithelium begins, especially as this has a rugous arrangement.*

That we have here to do with a form of digestion entirely anomalous and unprecedented I cannot believe, for I have several series of sections from animals which must have been without food for some time previous to death, in which the lumen of the intestine is not only free of food but of any obliterating mass of cells or plasmodium. The only protoplasmic bodies, not food, are certain Gregarina-like organisms adhering to the walls in various parts of the intestine, and which I consider to be parasites. These give, in sections, the appearance of the large "scattered cells entirely free from their surroundings" which Korotneff figures, and regards as "analogous to the great stomach-cell of Anchinia."

I am therefore forced to conclude that he has endowed the food-bearing mucous thread with a power it does not possess, and that Salpa does not exhibit any unusual form of digestion, and that there is no reason, on this account, for questioning the high genetic place occupied by the Tunicates.

Note on the Structure and Affinities of Phytoptus (Duj.).

By J. Playfair McMurrich.

The genus *Phytoptus* was established by Dujardin in 1851 (Ann. d. Sci. Nat.) for two forms of mites which he found on the Linden and Willow respectively, and which he characterized as possessing only two pairs of legs, an annulated abdomen and degenerated mouth-parts. These mites had been previously mentioned by Réaumur (Mem. pour servir á l'Histoire des Insectes, 1737), and by Dugés (Ann. d. Sci. Nat., 1834), who considered them larval forms of *Dermanyssus*, holding that all adult Acarina never possessed less than four pairs of legs. Dujardin perceiving ova in the abdomen considered the mites adult forms, but his observations were later called in question by Scheuten (Arch. f. Naturg., 1857), who agreed with Dugés that they were larval. It was left for Landois (Zeit. f. wissen. Zoöl., 1864), to set at rest the question as to their adult nature by a complete study of a form occurring on the leaves of the vine, but at the same time he confirmed Dugés' views that all adult mites possess eight legs by showing that two almost aborted limbs were present in addition to those described by earlier authors. So the matter remained for ten years, the additions to our knowledge of the *Phytopti* made in the interval being altogether faunistic, but in 1874, Löw disputed the presence of the rudimentary legs.

By a careful examination of *P. pyri*, Sch., I have been able to confirm Landois' statments. A pair of small tubercles may be seen on either side just anterior to the genital plate. They are smaller in the form observed than they are represented in Landois' figures, but nevertheless decidedly larger than the wart-like structures which support the body-setae. That these tubercles exist I have no doubt, but that they represent rudimentary legs is not quite so clear though, on *a priori* grounds, they must be supposed to be of that nature.

In classifications of the Acarina the Phytoptidæ have usually been placed close to the Trombididæ probably from the mode of life being in both cases similar. Morphologically, however, great differences exist between these two groups which can hardly be explained by degeneration. It appears to me that the *Phytopti* are much more closely allied to *Demodex* than to any other forms. In both there is the annulated cuticle of the abdomen; in *Demodex* the tracheal system is only very slightly developed, while in *Phytoptus* it is absent; the mouth-parts of the latter may be compared to the maxillæ and unpair stylet-like structure of the former, the mandibles having disappeared in accordance with the mode of life. *Demodex* differs in being less degenerate as shown by the presence of eight equally developed legs, and the occurrence of eyes, but on the whole the resemblance is greater than obtains between the Phytoptidae and other Acarina.

REPORT OF THE SECRETARY OF THE ARCHÆOLOGICAL SOCIETY OF THE JOHNS HOPKINS UNIVERSITY.

[Reprinted from the Ninth Annual Report of the Johns Hopkins University].

To the President of the Johns Hopkins University:

Sir: In accordance with your request that I would prepare a connected statement of what has been done during the past year in this University to encourage the study of Archæology, I send you the following report:—

A course of public lectures on Classical Archæology was given in Hopkins Hall during the spring months. The opening lecture, (January 14), by Dr. Waldstein, director of the Fitzwilliam Museum at Cambridge, (England), treated of the Influence of Athletic Games on Greek Art, from the time of its transition from the archaic stage to a closer study of the human form, until finally professional athleticism signalled a decline in the standard of taste and of art.

Mr. Joseph T. Clarke, who was in charge of the American archæological expedition to Assos, began his course (March 10) with a Plea for Practical Archæology, showing how the practical work accomplished in the present century has raised this study to the rank of a science; whereas, in the past, the immense material at hand could not be put to its proper use from the want of critical spirit. His two following lectures (March 12 and 14) were devoted to an account of the city of Assos, as disclosed by the excavations carried on for more than two years by the Archæological Institute. Besides the well known temple, with its interesting reliefs, the buildings of the Agora or market-place are unique for the insight they give us into the Greek methods of construction. They comprise the immense Stoa, the Bouleuterion, and the Bath. The series is completed by the Theatre, the Gymnasion, and the interesting street of tombs. The concluding lecture (March 17) on the Cyrenaica showed the exceptional advantages which would attend excavations in this early Greek colony, as yet almost unexplored. The city of Cyrene, with its extensive ruins above ground, offers peculiar attractions to the explorer.

Mr. W. J. Stillman, late U. S. Consul in Crete, lectured on March 19, 21 and 24. Prehistoric Research in the Classical Field formed the subject of his first lecture. He expressed the view that the ruins in Italy and Greece, that are commonly called Cyclopean or Pelasgic, were the work of a Pelasgic civilization which, having its seat in lower or central Italy moved southward leaving traces of its passage in Sicily, along the Illyrian shore, and especially through the Peloponnessus and Crete. The second lecture treated of the State of Research in Greece, and the great harm done to Art history and investigation by repressive laws concerning archæological researches. A well organized American school—not exciting like those of other nations the susceptibilities of the Greeks—would be the most potent possible agency to bring about a modification of the present law. In his third lecture, on the Relations of Art to Archæology, Mr. Stillman argued that true art was not imitation of nature, but the expression of an ideal of the human mind.

Dr. A. Emerson, Fellow in Greek, gave six lectures on Olympia, (March 26 to April 7.) He first gave an historical sketch of the Olympic festival, and described the various contests which took place on each of the five days during which the festival lasted. The people of Elis were the managers of the games, and this curatorship preserved to Elis its early independence. The character of the games declined greatly during the Roman period, until they were finally prohibited by Theodosius in 394. Although burned in 426, the temple of Zeus does not seem to have been fully destroyed until the great earthquake of 551. Of the architectural monuments of the Altis, the Heraion and the temple of Zeus were the most important. The former building, of uncertain but early date, establishes the wooden derivation of the Doric style. The temple of Zeus was founded in the 77th Olympiad by the Eleian architect, Libon. Paionios was the author of the sculptures of the Eastern pediment, and Alkamenes filled the Western pediment; the whole being under the direction of Paionios, who was awarded the prize in the competition. The sculptures of both pediments have been so far recovered by the German explorers that restorations in general unessential have been sufficient to complete them. Two *chefs d'œuvre* of free sculpture were also found in the excavations: the colossal marble Victory, by Paionios, and the Hermes holding the infant Dionysos, an early work of Praxiteles.

The concluding lecture (April 9) was by Professor Gildersleeve on the Relations of Literary and Plastic Art. The history of both these incorporations of national life shows many points of resemblance which were dwelt on in some detail. Our age has a better appreciation of both literature and art and these studies ought not to be dissociated.

In February, an Archæological Society was formed at the University for the voluntary prosecution of this study. Its meetings, which took place monthly, included the reading of papers on Ancient and Christian Art and reports on recent discoveries and investigations. At the first meeting (February 16), Dr. Frothingham discoursed on the study, past and present, of Christian Archæology, and its importance for obtaining a comprehensive view of history. Dr. Emerson reviewed the history of the study of Classical Archæology among civilized nations, especially during the last forty years. Maj. J. W. Powell, Director of the U. S. Bureau of Ethnology, gave an address on the Archæology of the Aboriginal Races of the United States, sketching the condition of handicraft among the different tribes. The meeting of March 14 was addressed by Mr. Clarke on the subject of the Entasis in Greek architecture, giving the results of original researches on the nature of the curved outlines of columns, employed by the Greeks to overcome an optical deception. Mr. Hoskins made a report on the collection of casts in the Peabody Institute. Mr. Stillman addressed the next meeting (March 22) on the Acropolis of Athens, describing its site, the means of access, and the principal buildings (the Parthenon and the Erechtheum); the lecture was illustrated by numerous photographs. A report on the works regarding ancient art contained in the Peabody Library was made by Dr. Emerson. At the last meeting (May 9) Dr. Frothingham read a paper on the history of Mosaic-painting since the Christian era, emphasizing the important place it holds in art-history, as it furnishes an almost unbroken series of well-preserved works during a period of twelve centuries. Dr. Emerson showed the interest of a well-organized and classified collection of electrotype reproductions of ancient coins.

In connection with the Society, Dr. Frothingham organized several circles for the study of various phases of Art, illustrated by photographs and art-books. At weekly meetings the following subjects were examined:

Romanesque Architecture. (March 1).
Gothic Architecture. (March 8).
Italian Sculpture during the XIII–XIV centuries. (March 22).
Italian Painting during the XIV century. (March 29).
Italian Painting during the XV century. (April 5).
Ivory Carving from the IV to the XIV century. (May 3).

The object of these informal lectures was to give a general idea of the subject studied, supported by such numerous representations as should give familiarity with the most characteristic works of the period.

The Archæological Institute of America which was founded five years ago for the promotion of archæological research and discovery on classical and American soil, has been during this time centred in Boston, although New York also furnished a considerable number of members. Feeling the danger of an interest too much centralized to be long efficient, the Council of the Institute at its meeting in Boston (May 17, 1884), proposed a new constitution by which the Institute should consist of affiliated societies in various cities. Wherever at least ten members organize they may form an affiliated society and send a member to the general council; a membership of fifty gives the right to a second delegate. Beside sharing in the general advantages of the Institute and influencing the work undertaken by it, these societies may create local interest by meetings, publications, etc. In order to further the formation of such a society in Baltimore, the University Archæological Society appointed Drs. Emerson and Frothingham as a committee. In a short time an organization of twenty-four members was formed and the "Baltimore branch of the Archæological Institute of America" was organized on June 5, with Mr. J. W. McCoy as president, and Drs. Emerson and Frothingham as recording and corresponding secretaries.

This newly formed society is quite distinct, both in its organization and in its aims, from that of the Johns Hopkins Archæological Society. The object of the University society is to excite among students in the various departments, an interest in the subject of art history and the first manifestations of early civilizations. It aims to attract the student of psychology by aesthetics, the student of history and philology by the valuable aid and suggestions it affords to both these departments.

The Baltimore branch of the American Institute, on the other hand, if it continue the custom which has hitherto been followed, will have but two meetings in the year. It consists both of those who take an active part in archæological work and of the patrons of art who are interested in furthering the efforts of American workers in a field so well cultivated by other nations. There can be no doubt that Baltimore will take, as is its due, an important share in giving this encouragement.

The valuable Cohen collection of Egyptian Antiquities, which has recently been acquired by the University, will be of great interest, not only for art, but for the historical study of the customs and laws of Egypt. It was begun in 1832 by Col. M. I. Cohen during his travels in Egypt, and consists of six hundred and eighty nine objects procured mainly in the localities where they were originally discovered. A number of objects, however, belonged to the famous collection of Mr. Salt, H. M. consul in Egypt, which was sold in 1835. The collection consists chiefly of small works illustrating the history of the minor arts in Egypt from the XVIII dynasty to that of the Ptolemies.

The University has also purchased plaster casts, on a reduced scale of 1:10, of the two pediments of the temple of Zeus at Olympia. They had recently been executed at Berlin, under the direction of Curtius and Hirschfeld, by the sculptor Grüttner.

The University, in connection with other American institutions, has continued for several years its subscription for the maintenance of the school of Classical Archæology at Athens.

A word may be now said on future work. One great difficulty in giving an educational impulse to studies in art history, especially for beginners, is the lack of reproductions from the originals. A systematic collection of photographs would be a most efficient and practical means of education, producing that familiarity with the monuments which is the first requisite towards gaining an insight into the study. This system was tried with success at the art circles described above. For the sum of three hundred and fifty dollars, a fine collection of about one thousand good sized photographs could be procured, which should illustrate all art periods, *e. g.:* Assyria, 60 ($35); Egypt, 60 ($35); Greece, 125 ($65); Rome, 100 ($25); Early Christian (Arch. Sculp. Paint.), 100 ($30); Romanesque and Gothic (Arch. Sculp. Paint.), 200 ($50); Renaissance, 150 ($35); Italian Painting, 200 ($60). Such a collection would be in continual use for the illustration of lectures or the inspection of art circles.

Most necessary also for classical archæology—as Dr. Emerson has shown—is a select collection of electrotype reproductions of ancient coins. It would illustrate admirably the history and literature of Greece and her colonies, and often also the condition of art in various provinces at the same period. The British Museum has, under the direction of Mr. Barclay V. Head, made such a collection of electrotypes divided into chronological and geographical sections. Specimens of the most important of these sections, consisting of a hundred and fifty coins, could be procured for the sum of $125; these would represent chronologically the history of the numismatic art from its beginnings in Greece (c. 700) to the age of Alexander, and geographically, the East, Greece proper, and the West.

A. L. FROTHINGHAM, JR.,
Corresponding Secretary of the
Johns Hopkins Archæological Society.

BALTIMORE, *November*, 1884.

REPORTS OF LECTURES, PAPERS, ETC.

Dr. Billings on the Place of the Science of Hygiene in a Liberal Education.

[On the sixth of November, 1884, Dr. J. S. Billings, U. S. A., Lecturer on Hygiene in the Johns Hopkins University, delivered a lecture before the officers and students of the University on the subject above named, and he has kindly furnished, in compliance with a request, the following abstract of his remarks.]

The lecturer commenced by stating what a course of study in Hygiene should include if established as part of the general course of instruction in the University. It would not include such detailed technical instruction as would be required by one proposing to become a sanitary engineer, or a medical officer of health, but it should include much more than mere general disquisitions on the laws of health, or than the so-called popular text books on Hygiene intended for the common schools. It would not include instruction in what is ordinarily called personal hygiene, because, to be of real value, advice on this subject must refer to individual cases and their wants, and because such instruction is already given in the department of Physical Training.

The course of instruction proposed would include an account of the principal causes of disease, including heredity, meteorology, the present position of the germ theory, etc., of water supply and its impurities, water analysis, methods of obtaining and storing water for use, water waste and its prevention, the pollution of streams, the disposal of water after it has been fouled by household use; of scavenging, including methods for the disposal of house refuse and sewage, the general principles of the so-called combined and separate systems of sewerage, and their modifications, house drainage and plumbing, heating and ventilation, and of the practical application of the general principles of sanitary construction, in both private habitations and public buildings.

Every well educated man should be able to form an intelligent opinion as to the sanitary condition of a house, a school building, or a hospital. He is liable at any time, as a citizen, to be concerned in the construction or management of some of these institutions, and must act in a judicial capacity upon the recommendations of people having opposing opinions, and sometimes, opposing interests. The habitations of the poorer classes, and especially tenement houses, and the best means of regulating these so that they shall not become causes of disease and immorality—and to do this without interfering unduly with private rights, which involves not only sanitary considerations but also some of the general principles of sociology and political economy, should also be a subject of instruction.

Food and its adulterations, the special dangers and nuisances connected with certain occupations, the proper modes of caring for the dead, the subject of vital statistics, including methods for taking a census, for registration of births, marriages and deaths, and of classifying, tabulating, and publishing the information derived from these, methods of preparing life tables, and of calculating expectation of life, and so much of the jurisprudence of hygiene as would enable the student to understand his own relations as an individual in this respect and those of the people to the State, and of the latter to the nation, including the general principles of laws establishing Boards of Health, the methods of checking the spread or importation of contagious or infectious diseases, quarantine, and the common law of nuisances were suggested as other proper subjects for instruction in such a course.

The special instruction given in certain foreign universities to those who are to become medical officers of health was then briefly described, and it was stated that the course proposed would include about twenty lectures, which should be fully illustrated, and a certain amount of reading, and working out of problems by the students occupying about as much time as the lectures, that is, that in all about forty hours would be devoted to the subject. Special laboratory work would not be necessary on the part of the students, but the teacher would require a room and some apparatus.

The arguments in favor of the establishment of such a course were briefly stated as follows: First, that the subject is worthy of study for its own sake without reference to utilitarianism. Second, that the knowledge thus gained would be decidedly advantageous to every professional man, and enable him to form an intelligent opinion as to the influence which his surroundings would have upon the health of himself and his family, enable him to take timely steps for prevention, and to protect himself from being unnecessarily alarmed or unduly swindled by charlatans in the guise of sanitarians. If he is to become a teacher, a manufacturer, or head of a large business of any kind, a leader in any capacity, he must make use of other men as material, as assistants, as tools, and his success will depend in no small degree upon the intelligent care with which he keeps such material and tools in the best possible condition as regards physical health.

Those motives, however, which depend mainly on the desire for the gratification of personal taste and wishes, or for what is calculated to advance one's personal well being and interest are not the highest motives which can be presented in favor of a given course of investigation or study. Under the existing conditions of civilized life in which we find ourselves,—and especially under the conditions in which a liberally educated citizen of the United States is placed, there are incumbent upon him certain duties in his relations to his fellow man which are of great importance, and to properly fulfil which he should endeavor to prepare himself. Of the importance of health to the community, or the nation, of the desirability that we should have among us the largest possible number of healthy men, of men who live long and vigorously, and who when they die leave healthy offspring there is no need to enlarge. Much has been done in other countries within the last twenty-five years to improve the public health, to diminish sickness, and to prolong life. There is need of improvement in this respect in this country and this need will rapidly increase with the growth of population. The possibility of making such improvements depends on the growth and development of enlightened public opinion, on the education of the people, and this education must extend to all classes and to all professions.

While the training of specialists is important, we have also great need for intelligent, well educated men in the general occupations of life, who shall be bankers, business men, railroad men, clergymen, lawyers, judges, and legislators.

Every well educated man is in his own circle the leader of others, who will be governed by his opinion in matters of public policy such as involve legislation affecting the public health, the preservation of pure water supply, the propriety of introducing a system of sewerage, etc. Such a course as is proposed would also be valuable to the specialist, if for no other purpose than to give a certain amount of breadth to the foundations of his special knowledge, in which such knowledge is too often lacking.

In the medical profession the tendency at present is to begin to specialize too soon, and this is a danger which should receive consideration in planning for the higher education of the young men of this country.

The objections to the establishment of such a course were summed up as follows: First, that there is no existing demand on the part of students for it. Second, that the subject is not yet on a scientific basis. Third, that the present course of instruction given in the chemical, physical, and biological departments of the University include all that a well-educated man need know of this subject unless he proposes to make it a specialty. Fourth, that the students have no time for any studies additional to the course already supplied.

To the first objection the reply was that the same might be said as to other branches of the curriculum—that the majority of students do not know what they ought to study—and that the question is whether the time has not come to create the demand and for the University to lead the way in the matter. The second objection is only partly true. The general rule holds good in man as it does in the laboratory, that like causes under like circumstances will produce like effects. When it has been shown in a number of well-marked cases that polluted water has been the means of spreading typhoid fever, that overcrowding and foul air precede epidemic typhus, that scarlet fever or diptheria has been conveyed to a village by infected clothing from a distance, we have enough information to enable us to advise in similar cases, although we also know that men have drunk sewage with impunity and that unprotected children have slept in the same bed with a scarlet fever case and have not taken the disease.

The two last objections the lecturer did not discuss, saying that his audience (the professors and students) could better judge of their importance than himself, but expressing the hope that they would not be found to be very serious ones in practice.

Mr. A. M. Elliott on a Philological Expedition to Canada.

[Abstract of a paper read at the meeting of the University Philological Association, October 3, 1884].

The object of this communication was to give some details with reference to the French Canadians of the Province of Quebec, among whom the writer passed about two months of last summer for the purpose of studying the local customs, traditions, and language of the people. The territory chosen for work was that represented by the valley of the St. Lawrence, between Montreal as the western, and Quebec as the eastern end of the line. To the west of the former, as far as Ottowa, I was able to collect a few data bearing upon the gradual mixture of the French and English, which will be shown elsewhere to have special interest for the philologian, while to the east of the latter, my observations were extended to a few points down the river as far as the small village St. Tite, about forty miles below Quebec. The distance between the two extremes of my working line measures exactly one hundred and eighty miles, and will doubtless appear to those unacquainted with the linguistic territory as far too extensive to be characterized with even a moderate degree of accuracy. To this doubt I must reply that, acting the part of pioneer, my chief object was to gather the leading features of the language and thus establish the main local characteristics which it is necessary to know before individual centres can be worked out with profit. In doing this, to my great surprise, I found a uniformity of speech for this whole district which must impress, as little less than wonderful, every one who has been accustomed to note the great and often puzzling differences of idiom that exist in European countries. The causes that produced this sameness of word-form and expression are too complex to be more than hinted at here, but their effects are easily traceable in the community of language of the *habitant* and the city bred, of the uneducated and the learned. My plan of operation for the above named territory was to select certain localities that would serve as bases to move from. These were naturally the ends of the linguistic line and its middle point, that is, Montreal, Three Rivers, and Quebec, which cities I took as so many centres and worked out towards the circumference or limits of the region examined, extending back in some cases to more than fifty miles from the St. Lawrence River.

To understand the present institutions and the language of this tract of country, we must know something of the peculiar history of the branch of the French people, who have inhabited it, and who from many points of view (ethnological, social, religious and linguistic) are certainly one of the most interesting of modern civilization.

Although Jacques Cartier discovered the St. Lawrence in 1535, it was not till about three quarters of a century later (1608) that the first settlement was made by the "True Father of Canada," Samuel de Champlain, on the present site of Quebec. A little more than three decades later (1642) the foundations of *Ville-Marie de Montreal* were laid by Paul de Chomedey, Sieur de Maisonneuve. Champlain was sent out by a company of associated noblemen of France with the distinct purpose, in addition to the establishment of commercial relations, of opening a new field for the Christian religion. Duty was the guiding star of Maisonneuve's life, and in this original name of the city of Montreal we have an indication that the early settlement was the result of religious enthusiasm. "It shows an attempt to found in America a veritable Kingdom of God, as understood by devout Roman Catholics." * We must keep steadily in mind this deep religious sentiment that animated the founders of the colony if we would understand the extraordinary faith of the people to-day, for nowhere else, perhaps, has belief a stronger living power than with these our neighbors of the North. Here the *Angelus* continues to practically solve the labor question that is vexing the rest of Christendom; here the dictum of the Priest or Bishop is sufficient in many places to make the people forego the pleasures of the dance and other innocent amusements; here is the land of miracles where the earnest, faithful pilgrim, whether halt or blind, is restored to the full vigor of his bodily functions under the quickening energy of some saint; where the rich and the poor, the well and the sick flock by tens of thousands to holy shrines to receive the rewards of their
piety in greater personal comfort or in other temporal blessing
necessity thus arises for the clergy to constantly mix with 'the
which has a direct and notable influence upon the speech bot
former and of the latter.

For more than two hundred years New France remained in pos
the French, and the unity of the province was not molested till thi
after the British Conquest (1760). Ontario was then set apart
exiled loyalists of the revolted colonies. At the time Canada pass
British crown she barely numbered 60,000 souls, and now, after on
tury and a quarter, she counts within her own borders about 1,500,
ple, produced entirely by natural increase (for there is no imn
from France), and has sent to the United States 500,000 inhabitant
the last twenty years. It is a most common thing to find fa
twenty-five to thirty children by the same mother, and it has b
properly suggested that "if at this present time the French race
a vitality in Canada as mysterious to its enemies as to the Frenc
the France to-day, it is because of the imperishable power, of the s
fice and heroism of so many of those men, laymen as well as cle
planted the standard of France on the shores of the St. Lawrence."

As a natural effect of this rapid increase in population we find a
uprooting of the weaker race in point of numbers, that is, the
The wonderfully absorbing power of the French element in Lowe
has produced the curious phenomenon of a people in certain sectio
country bearing all the racial characteristics of the English or Sc
blue eyes, light hair and florid faces), and having the name of
Fraser, McDonald, McPherson, etc., but still unable to speak a wo
mother tongue. The English names of roads, of towns, of coun
evidence as to who were the occupants of the soil a few years ago.
it is the offspring of the Gallic stock who possess the land.

Not only this; the French are running over their territorial b
in both directions, east and west, and from the province of Upper
the peculiar heritage of the English, they have already one repre
in the National Assembly. Their unswerving purpose, encourage
clergy, is to take back their old domains by the peaceful process o
lating them with descendants of their own blood, and, at the prese
increase, we may safely predict that it will not be many generatio
they shall have accomplished this unique feat.

Another feature of external influence upon the language must
in the original seigniorial tenure which prevailed throughout Lowe
The Seigneurs were the second sons of noble families who chose t
class of peasants to accompany them to their homes in the New W
here each ruler laid out on the river his little kingdom (gener
leagues in dimensions), which he divided among his colonists in co
of 3 x 30 arpents. This arrangement produced a series of centres
zation in which the lord and his educated friends were brought i
or less intimate contact with the common people; in truth, we ha
dant evidence to show that the relation of the Seigneur to his p
much more intimate in these early settlements of Canada tha
mother country. After the conquest (1760) nearly all the noble
country, and the different classes of society were more thorough
than they had ever been before. They united against a commo
who made more than one unsuccessful attempt to deprive them
dearest heritage after their religion, that is, their language.
ately attached to both these, their national existence found e
in literature (History, Fiction, Poetry), but their children t
descendants of ante-revolutionary France, are separated in tho
feeling by a great gulf from modern France.

The influence of long and constant contact with a Teutonic rac
the effect to temper the rash impulses of the Gaul, and this is in n
more marked than in his speech, where a quiet monotony largel
and strikes the stranger immediately as one of its leading chara
It has not the rhythm, the inexhaustible variety and rich caden
Gallic tongue as it is spoken to-day in France. The people are
proud of their language all the same, yet in their literature there
vile imitation of French models. The motives for it are drawn
rich sources of their own history, popular tradition and social life
treatment of these subjects often impresses the reader as having s
of the verve and manly diction of the old chroniclers, coupled
polish of the modern schools. Their popular songs are very num

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* Dawson: Handbook for the Dominion of Canada. Pages 123, 149. Montreal, 1884.

te a large body of literature in themselves. Many of them were ınted to the soil of the North more than two hundred years ago, :ittany and Normandy, and represent that common genus of minor folk-song, so frequently found in North Spain, Provence, France, any others, again, are of native growth, illustrating themes of popupathy or individual experience in the history of the early settlers. 'e more than in Canada does this species of literary composition erve the important purpose of strengthening a feeling of common and fortifying the national spirit, and in the full consciousness of ing power the leaders of this people to-day may well accept the m of old Fletcher: "Give me the making of songs for the people ıre not who makes the laws."

int of language the Canadian French is certainly one of the most ing topics for a philologian. Here we find that time has stood still, ly for the more remote rural districts, and the scholar could easily himself holding intercourse with the subjects of Louis XIV. This hat we have the unique privilege in this age of steam and travel of g in them a form of speech that has scarcely known change for the centuries. But this idiom is not a dialect of that remote period, and ıtest surprise to a student of language arriving in Canada is to find ntrary to the general impression of scholars, the vernacular does not y specific dialectic character, but is the Middle (sixteenth century) with those natural changes which would be produced by the intision into a whole of all the different species of language that were lly brought from the mother country. The commonest *Habitant* ands French and the stranger will easily follow him in conversation, d he knows the terms and forms of the old language. The next neral characteristic of this striking type of speech is the colorless ıity of pronunciation referred to above. Displacement of accent ı), the sonant character of final consonants, especially the *t* in proper (Nicolet); the imperfect articulation of the *r*—all these are more or iceable everywhere and are doubtless due to the influence of contact e English. The further general syncopation of *emutum*, as in *j'f'ra*, *nez* and the extensive application of the "Law of Least Action" in contractions, such as *j' m' a* (*a* in English *father*) for *je m'en vais* are n and make the language, for a short time, rather difficult to be ood by the uninitiated.

he Phonetics the most notable deviation from the modern French s found in the variety of sound-shading given to one and the same sign where the Parisian often has but one or at most two species to . This holds true for the vowel, and more particularly for the diph-; for example, in the *oi* and *eu* combinations. In both of these we ıree distinct nuances of sound, namely, for the former, 1, *oi* = *ea* in ı *wear, swear;* 2, *oi* = French *oé* (*moé*); 3, *oi* = the abnormal modern *wa*; for the latter, 1, *eu* = the ordinary French phonetic equivalent ın *ö*); 2, *eu* = simple French *u* (German *ü*); 3, *eu* = a sound midtween these two and which I designate by *ü*. The *a*, too, gives us istinct kinds, viz: 1, *a* = *a* in English *all*; 2, *a* = *a* in English *father;* the common flattened French *a*. The Norman *ar* for *er* (*travarser*, , etc.,) is universal, and the strengthening of *i* to *a* most common, *e. g.*, (shilling), *Ballé* (Billy), etc.

the consonants the palatalization of the guttural mutes is one of the d most striking peculiarities that a stranger is likely to notice; for le, *trankjille* (tranquille), *kjeu* (queue), *vainkjeur* (vainqueur). Cf. Vir-*kjar* (car), *gjirl* (girl). Again, the interchange of palatalized *t* and *k* *oikjé* (moitié), and the substitution of the former for simple guttural as in *tjuré* (curé); or the replacing of simple dental by palatalized ıl, *e. g.*, *kjuer* (tuer). The syncopation of a palatalized dental sonant e development afterwards of the palatal vowel into its corresponding owel state is found everywhere, as in *Canayen* (Canadian). *R* fre-y undergoes the same vocalization, *e. g.*, *cayottes* (*carottes*). Pros-epenthetical and epithetical elements abound, especially for strong , as in *tsour* (*sous*), *tsur* (*sur*), *i n'y a t officiers*, *léjart* (*une voiture léjart*).

morphology gives us more interesting examples of Folk-treatment, example, the article *il* = *i*, *ils* = *iz;* all adjectives in *if* are invariable *mme vif);* the numerals ending in *s* have feminine forms (*troises*); all new creations of verbs on English stems are thrown into the ugation, *e. g.*, in *bit-er* (beat), *scrép-er* (scrape), *slak-er* (to slack), (log) = to roll logs together, while in the formative period of French those hybrid compounds were distributed between the *A*-and *I*-forms, as is seen in modern French *garnir* (= *A. S. varnian*); Old French *gandir* (=Goth. *vandjan*). Among the older inhabitants especially we hear *j'avions*, *j'étions*, etc., similar to the custom of verb-usage in rural districts of France.

For the syntax I will note here only one general characteristic, that is, the universal omission of the real negative particle in the combination *ne-pas*, *e. g.*, *j'pense pas* (for *ne pense pas*), *j'aime pas*, etc. This phenomenon is interesting in that it simply carries one degree further the tendency of the classical language to make the Latin *passus* share the burden of negation with its legitimate representative *ne*. The supplementary particle finally comes to take the place of the primitive element altogether. Old French words and expressions are naturally found everywhere in the greatest abundance and original French terms, with special uses peculiar to the Canadians, are numerous. Among the latter we may cite *cailler* = *s'en dormir*, *butin* = Norman for "clothes", *mouiller* (taking effect for cause) = *pleuvoir*, *poudr-er* (from *poudre*) = to snow a fine, mealy snow; *embarquer*, *débarquer*, for *monter*, and *descendre* with reference to a vehicle, *mouver* = "to move household effects," etc., etc. But it is not alone old words and new uses of modern terms that meet us here. The special formations in Canadian French are very extensive and often serve to show how the classical language was probably built up by adding one analytic product to another. From the Latin *quasi* we have the adverb *casiment*, and so, too, from the modern French *presque* (*pressum quod*), the Canadian, in generalizing his adverbial categories, produces *presquement*. After the manner of the early creations in the language he has no scruple in producing a simple verb *venter* = "to blow" (used of wind) from the substantive *vent* and from *gens* he strikes out *engenser* in the same mould which his ancestors used for the production of similar verbal parasynthetics with the relational *en*.

Following again in the footsteps of the early makers of his language in adapting Latin flexions to Gothic and German stems, he says, *sidez les chars* (= to run cars off the main on to the side track of a railroad), *le cheval a bolté* (= "the horse bolted"), *blackballer*, etc., etc. It is, however, in the province of proper names where we find to-day the most extraordinary phenomenon, perhaps, in the whole range of creations with which the French Canadian has enriched his native tongue. We are so accustomed to think the supply of material sufficient for the demand in this department of word-formation and, therefore, the name-book has been closed, that we can scarcely believe the evidence of our senses when we suddenly face a people with whom the process of proper-name creation is in full force and of daily occurrence. Such is the case in Canada. A single example will suffice to illustrate one phase of this procedure. Monsieur Guérin has two sons named, respectively, Charles and Jacques. The former is a special favorite of his father and receives the soubriquet *la joie*, that is, Charles Guérin dit La Joie. As said Charles grows up he drops entirely the name of his father (Guérin) and is only known as Monsieur Charles La Joie, his brother all the time continuing to bear the original designation of his father's family. It thus constantly happens that two persons or two households most closely connected in blood relationship have wholly different names, and these new soubriquets serve again in their turn for the production of other appellations.

In the above *résumé* I have tried to give simply a few salient points along the line of investigation which I have followed in collecting material for a scientific treatment of the Canadian French language. I hope in a few months to begin to publish the results of my work.

Mr. Mendes Cohen on "the Cohen Collection of Egyptian Antiquities," and its Collector, Colonel Mendes I. Cohen.

[Read at a meeting of the University Archæological Society, November, 1884].

In view of the recent transfer to the Johns Hopkins University of the collection of Egyptian Antiquities, formed by Colonel Mendes I. Cohen, and from which we have a few objects before us to-night, it has been thought fitting by the president of the University, that I should present a few notes in regard to the collector, and briefly narrate how it came about that there should have been gathered here the ancient relics, which for the last fifty years have rested together in the cabinet of their collector and owner, at his late residence in this city.

Mendes I. Cohen was born in the city of Richmond, Virginia, on May 25, 1796, and died at Baltimore on May 7, 1879. He was the third son of Israel and Judith Cohen, who came to America from England immediately after their marriage in 1787 and settled at Richmond, where an older brother, Jacob I. Cohen, who came over before the revolution and had served honorably as a soldier in the South Carolina campaign of 1778–1779, under Moultrie and Lincoln, was already established as a successful merchant and man of prominence.

Israel Cohen died in 1803, and his widow, with her seven children, of whom the subject of these notes was the fourth, removed from Richmond to Baltimore. In this city the children received such educational advantages as the town afforded.

At the breaking out of the war of 1812–1814, three of the brothers enrolled themselves for the defence of the city in Captain Nicholson's company of artillery, and at the bombardment of Fort McHenry, Mendes, then eighteen years of age, together with an older brother, Philip, served with their company in the successful resistance of the British attack. This period of peril and excitement seems to have put an end to attendance at school, and shortly thereafter he became engaged in business. Somewhat later he joined his brothers as a member of the banking firm of J. I. Cohen, Jr., & Brothers, and conducted at New York the branch of the house in that city.

In 1829, having acquired a reasonable competency, Mr. Cohen determined to retire from the firm and from all business, and to gratify his taste for observation, study and matters of art by travel in foreign lands. He sailed for Europe in October of that year, and after traversing England, France, Switzerland, Italy and parts of Turkey reached the Levant in January, 1832. At this time hostilities prevailed between the Sultan and Mehemet Ali, viceroy of Egypt, and on landing at Beyrout, in Syria, Mr. Cohen found the town and surrounding country in possession of the viceroy's troops. His route to Jerusalem took him by way of St. Jean D'Acre, then being beseiged by the army of Ibrahim Pasha, son of the viceroy. He became a guest for a week or more in the camp of the Pasha, and the personal acquaintance there formed with the Egyptian commander and his officers, and subsequently with Mehemet Ali himself, greatly facilitated the progress of our traveller throughout the valley of the Nile and afterwards in his journey through Asia Minor.

He left Damietta early in April, 1832, in his own *Kangea*, or sailing vessel, chartered for the voyage and ascended the Nile as far as the Second Cataract, *Wady Halfa* in Nubia, stopping at all points of interest and making excursions on either side of the river as occasion and curiosity suggested.

It may be noted that on this expedition our national flag was displayed on the river for the first time. The flag, which is still preserved, was made with the aid of an Arab servant from material purchased at Manfalout, one of the river towns. It was saluted in due form on being hoisted whilst the boatmen swore, over a cup of *rakee* apiece, to defend it against all enemies.

At Luxor during his ascent of the river he had a pleasant interchange of courtesies with the French Naval Officers engaged in the work of removing the Obelisk, which now ornaments the Place de la Concorde at Paris.

More than four months and a half were occupied in this voyage on the Nile, during which, without having himself undertaken any costly excavations, he lost no opportunity to acquire objects of antiquarian value, when such were obtainable from first hands, or from sources which left no doubt as to their authenticity. These form the basis of the collection which we are now considering. Most of the objects were procured at Thebes, or Memphis, others at various points, whilst a portion was acquired by purchase at the sale in London in 1835, of the great collection of Mr. Consul-General Salt. In every instance the catalogue which accompanies the collection names the locality where the specimens were obtained.

The collection which consists of some 680 numbers, includes:

Statuettes in *bronze* of the various deities and a few of animals.

Amulets in many varieties in enamel, porcelain, and stone of different kinds.

Amphorae of various sizes and shapes and of different materials.

Vases in alabaster, terra cotta, and basalt.

Rings in enamel, carnelian, bronze, and gold.

Scarabaei of many different sizes and materials, some with and some without hieroglyphics, and a few with *cartouches*. One of the latter, and obtained too at Thebes, has been noted in the catalogue as *false?* This specimen has not however been withdrawn from the collection for unless the verdict of the catalogue be on further examination disaffirmed, the specimen will at least serve in its present position as an aid to the student in learning to distinguish the *false* from the *true* in Egyptian art. There are also included many *necklaces* of carnelian, jasper, amethyst, lapis lazuli, serpentine and of beads and bugles.

Numerous figures of mummies in stone and in porcelain of different colors, memorials of the dead, some covered with hieroglyphics and others without.

Figures of mummies in wood with and without hieroglyphics and with and without receptacles for papyri.

A mummy of a youth, in perfect preservation. The mummy of an adult, enumerated in the original catalogue, was opened many years ago at the University of Maryland, and has now probably entirely disappeared. There will be found several portions of human mummies which serve to illustrate the method of wrapping.

There are also numerous specimens of embalmed dogs and cats and of the ibis and crocodile.

Sets of Canopi hollow and solid.

An interesting object is the figure of the boat for conveying the mummy to its final resting place. It is of wood with four human figures of same material. There are also various objects of domestic use amongst the ancient people.

I may conclude my enumeration by mentioning a fine specimen of a *stele* or tablet in limestone with figures and hieroglyphics deeply cut and remarkably well preserved, and a *sphinx* in limestone, which is also quite interesting.

Mr. Cohen after a brief rest at Alexandria at the conclusion of his voyage, returned to Cairo, and thence set out by caravan across the Desert to Mount Sinai and by way of Gaza to Jerusalem, whence he continued his journey by land through Asia Minor. At Kutahieh, he again found himself at the head-quarters of Ibrahim Pasha, whose army of twenty thousand men was there encamped. After a few days' rest he continued on his way to Constantinople, (his second visit) being permitted to pass the military lines without serious difficulty.

From Constantinople he travelled North through Bulgaria and Moldavia to Odessa, thence through Russia by way of Charkov to Moscow and thence to St. Petersburgh. Here he turned his course again to the southward and passed through the lower Baltic Provinces and Poland to Cracow. Thence he traversed Austria from North to South, passing by way of Vienna, and crossing the Julian Alps he came out upon the Adriatic at Trieste.

From this point he crossed to Italy and passing through Venice and the Tyrol, made a winter crossing of the Rhoetian Alps, and entered Germany about the middle of January, 1834.

It may not be of general interest to follow him further on his route, which was now continued for about eighteen months in more frequented parts. He reached home on the 27th of August, 1835, having been absent nearly six years on his travels and having passed nearly two years of that time in Egypt, Asia Minor, and the Countries of the Levant.

He was a man of sound judgment and of remarkable determination of character, whilst all his habits of life were marked by moderation and regularity. To these traits may no doubt be attributed his enjoyment of perfect health throughout his journeyings. Neither the extreme summer heat of an Arabian Desert nor the severe cold incident to winter crossings of the Alps, seems to have affected him.

He possessed a refined and cultivated taste and was always glad to impart a knowledge of his varied experiences to those who sought information from him. In this way a narrative of his journey through Asia Minor was contributed to the Royal Geographical Society on his return to London; and in the same way his collections were always readily at the service of those who knew how to avail of them, so that it gave him pleasure to accord their use to illustrate the course of lectures on Egyptian Archæology delivered in Baltimore in 1845, by Mr. George R. Gliddon, formerly our consul at Cairo.

The family of Colonel Cohen have naturally felt a pride in the collection, and a desire that it should remain in this community; it is therefore with especial pleasure that his nephews, to whom he bequeathed it, have

REPORTS OF LECTURES, PAPERS, ETC.

Dr. Billings on the Place of the Science of Hygiene in a Liberal Education.

[On the sixth of November, 1884, Dr. J. S. Billings, U. S. A., Lecturer on Hygiene in the Johns Hopkins University, delivered a lecture before the officers and students of the University on the subject above named, and he has kindly furnished, in compliance with a request, the following abstract of his remarks.]

The lecturer commenced by stating what a course of study in Hygiene should include if established as part of the general course of instruction in the University. It would not include such detailed technical instruction as would be required by one proposing to become a sanitary engineer, or a medical officer of health, but it should include much more than mere general disquisitions on the laws of health, or than the so-called popular text books on Hygiene intended for the common schools. It would not include instruction in what is ordinarily called personal hygiene, because, to be of real value, advice on this subject must refer to individual cases and their wants, and because such instruction is already given in the department of Physical Training.

The course of instruction proposed would include an account of the principal causes of disease, including heredity, meteorology, the present position of the germ theory, etc., of water supply and its impurities, water analysis, methods of obtaining and storing water for use, water waste and its prevention, the pollution of streams, the disposal of water after it has been fouled by household use; of scavenging, including methods for the disposal of house refuse and sewage, the general principles of the so-called combined and separate systems of sewerage, and their modifications, house drainage and plumbing, heating and ventilation, and of the practical application of the general principles of sanitary construction, in both private habitations and public buildings.

Every well educated man should be able to form an intelligent opinion as to the sanitary condition of a house, a school building, or a hospital. He is liable at any time, as a citizen, to be concerned in the construction or management of some of these institutions, and must act in a judicial capacity upon the recommendations of people having opposing opinions, and sometimes, opposing interests. The habitations of the poorer classes, and especially tenement houses, and the best means of regulating these so that they shall not become causes of disease and immorality—and to do this without interfering unduly with private rights, which involves not only sanitary considerations but also some of the general principles of sociology and political economy, should also be a subject of instruction.

Food and its adulterations, the special dangers and nuisances connected with certain occupations, the proper modes of caring for the dead, the subject of vital statistics, including methods for taking a census, for registration of births, marriages and deaths, and of classifying, tabulating, and publishing the information derived from these, methods of preparing life tables, and of calculating expectation of life, and so much of the jurisprudence of hygiene as would enable the student to understand his own relations as an individual in this respect and those of the people to the State, and of the latter to the nation, including the general principles of laws establishing Boards of Health, the methods of checking the spread or importation of contagious or infectious diseases, quarantine, and the common law of nuisances were suggested as other proper subjects for instruction in such a course.

The special instruction given in certain foreign universities to those who are to become medical officers of health was then briefly described, and it was stated that the course proposed would include about twenty lectures, which should be fully illustrated, and a certain amount of reading, and working out of problems by the students occupying about as much time as the lectures, that is, that in all about forty hours would be devoted to the subject. Special laboratory work would not be necessary on the part of the students, but the teacher would require a room and some apparatus.

The arguments in favor of the establishment of such a course were briefly stated as follows: First, that the subject is worthy of study for its own sake without reference to utilitarianism. Second, that the knowledge thus gained would be decidedly advantageous to every professional man, and enable him to form an intelligent opinion as to the influence which his surroundings would have upon the health of himself and his family, enable him to take timely steps for prevention, and to protect himself from being unnecessarily alarmed or unduly swindled by charlatans in the guise of sanitarians. If he is to become a teacher, a manufacturer, or head of a large business of any kind, a leader in any capacity, he must make use of other men as material, as assistants, as tools, and his success will depend in no small degree upon the intelligent care with which he keeps such material and tools in the best possible condition as regards physical health.

Those motives, however, which depend mainly on the desire for the gratification of personal taste and wishes, or for what is calculated to advance one's personal well being and interest are not the highest motives which can be presented in favor of a given course of investigation or study. Under the existing conditions of civilized life in which we find ourselves,—and especially under the conditions in which a liberally educated citizen of the United States is placed, there are incumbent upon him certain duties in his relations to his fellow man which are of great importance, and to properly fulfil which he should endeavor to prepare himself. Of the importance of health to the community, or the nation, of the desirability that we should have among us the largest possible number of healthy men, of men who live long and vigorously, and who when they die leave healthy offspring there is no need to enlarge. Much has been done in other countries within the last twenty-five years to improve the public health, to diminish sickness, and to prolong life. There is need of improvement in this respect in this country and this need will rapidly increase with the growth of population. The possibility of making such improvements depends on the growth and development of enlightened public opinion, on the education of the people, and this education must extend to all classes and to all professions.

While the training of specialists is important, we have also great need for intelligent, well educated men in the general occupations of life, who shall be bankers, business men, railroad men, clergymen, lawyers, judges, and legislators.

Every well educated man is in his own circle the leader of others, who will be governed by his opinion in matters of public policy such as involve legislation affecting the public health, the preservation of pure water supply, the propriety of introducing a system of sewerage, etc. Such a course as is proposed would also be valuable to the specialist, if for no other purpose than to give a certain amount of breadth to the foundations of his special knowledge, in which such knowledge is too often lacking.

In the medical profession the tendency at present is to begin to specialize too soon, and this is a danger which should receive consideration in planning for the higher education of the young men of this country.

The objections to the establishment of such a course were summed up as follows: First, that there is no existing demand on the part of students for it. Second, that the subject is not yet on a scientific basis. Third, that the present course of instruction given in the chemical, physical, and biological departments of the University include all that a well-educated man need know of this subject unless he proposes to make it a specialty. Fourth, that the students have no time for any studies additional to the course already supplied.

To the first objection the reply was that the same might be said as to other branches of the curriculum—that the majority of students do not know what they ought to study—and that the question is whether the time has not come to create the demand and for the University to lead the way in the matter. The second objection is only partly true. The general rule holds good in man as it does in the laboratory, that like causes under like circumstances will produce like effects. When it has been shown in a number of well-marked cases that polluted water has been the means of spreading typhoid fever, that overcrowding and foul air precede epidemic typhus, that scarlet fever or diptheria has been conveyed to a village by infected clothing from a distance, we have enough information to enable us to advise in similar cases, although we also know that men have drunk sewage with impunity and that unprotected children have slept in the same bed with a scarlet fever case and have not taken the disease.

The two last objections the lecturer did not discuss, saying that his audience (the professors and students) could better judge of their importance than himself, but expressing the hope that they would not be found to be very serious ones in practice.

PUBLIC LECTURES.

I. SPANISH AND PORTUGUESE LITERATURE.

A course of ten lectures on Spanish and Portuguese Literature in Hopkins Hall, beginning Thursday, November 13, and continuing on successive Tuesdays and Thursdays till December 18.

MR. H. A. TODD, Instructor in the Romance Languages, three lectures on *Contemporary Spanish Literature*, as follows:

I. *Thursday, November* 13. Contemporary Poetry in Spain.

Condition of Spain from the Peninsular War to the present. Literary Influence of Byron and the French Romantic School. *Larra* and *Espronceda.* The older generation of living poets: *Zorrilla; Campoamor.* The younger school: *Nuñez de Arce; Selgas.*

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Larra: Obras Completas, Madrid, 1843.
Espronceda: Pelayo; El Diablo Mundo; Poesías liricas.
Zorrilla: Cantos del Trovador; Grenada; Don Juan Tenorio; El Caballo del Rey Sancho; El Alcalde Ronquillo; El Zapatero y el Rey.
Campoamor: Pequeños poemas; Poesías y Fabulas; Doloras y Cantares; El Drama Universal; Utilidad de las Flores.
Nuñez de Arce: Haz de leña; Gritos del Combate; Raimundo Lull; La ultima lamentacion de Lord Byron; El Vértigo; La Vision de Fray Martin.
José Selgas: La Primavera; Hojas sueltas; Otras hojas sueltas.
La littérature espagnole contemporaine: Les Romanciers et les poètes, par Léo Quesnel. (Nouvelle Revue, tome XVIII, p. 128, 1882).
Un poète lyrique espagnol: Don Gaspar Nuñez de Arce, par L. Louis-Lande. (Revue des Deux Mondes, tome XXXIX, p. 414, 1880).
Modern Poets and Poetry of Spain, by James Kennedy. London, 1852.
Poems translated from the Spanish and German, by Henry Phillips, Jr. Philadelphia, 1878.

II. *Tuesday, November* 18. The Modern Spanish Novel.

Recent discussions of the Art of Fiction. Home competition of Spanish with Foreign Novelists. *Fernan Caballero. Antonio de Trueba. Pedro Antonio de Alarcon. Juan Valera. Perez Galdos.*

BIBLIOGRAPHY.

Fernan Caballero: La Gaviota; La Familia de Alvareda; Cuentos y poesías populares andaluces; Relaciones; Elia; Cuadros de Costumbres; Cuartro Novelas.
Antonio de Trueba: Las Hijas del Cid; El libro de los Cantares; Cuentos campesinos; Cuentos populares; El Redentor moderno.
Pedro Antonio de Alarcon: Diario de un Testigo de la Guerra de Africa; El Sombrero de tres picos; La Alpujarra; Final de Norma; El Escándalo; La Prodiga; Novelas Cortas.
Juan Valera: Pepita Jimenez; Las Ilusiones del Doctor Faustino; Daphnis y Chloé; Doña Luz; El Comendador Mendoza.
Perez Galdos: Episodios nacionales, primera y segunda série; Doña Perfecta; Gloria; Marianela; La familia de Leon Roch; El Doctor Centeno.
Un Roman de moeurs espagnol: Pepita Jimenez, par L. Louis-Lande. (R. des Deux Mondes, tome VII, p. 471, 1875).
La Casuistique dans le Roman, à propos d'un Roman espagnol, par F. Brunetière, (R. des Deux Mondes, tome XLVIII, p 453, 1881).
Rassegna delle letterature straniere: Valence et Valladolid, Nouvelles Etudes sur l'Espagne, (Nuova Antologia, VI, 202, 1877).

III. *Thursday, November* 20. The Orators and Drama of Modern Spain.

Relation of the Drama to Poetry and Oratory. The Spanish Stage toward the middle of the present century. Popular interest in the Theatre. *Breton de los Herreros and Hartzenbusch. Gertrudis de Avellaneda. José Echegarray. Castelar and Cánovas del Castillo. Menendez Pelayo.* Summary of the course, with critical estimate of literary achievements and tendencies in Spain during the XIXth century.

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Coleccion español: El teatro moderno. Brockhaus, Leipzig.
Breton de las Herreros: Marcela; El tercero en la discordia; El pelo de la dehesa; Una de tantas; Un cuarto de hora.
Hartzenbusch: Obras escogidas.
Avellaneda: Alonzo Munio; Recaredo; Errores del Corazon; La Hija de las flores.
Echegarray: La muerte en los labios; El gran Galeoto; Conflicto entre los deberes.
Castelar: Formula del Progreso; Ernesto; La hermana de la caridad; Ricardo; Historia de una corazon; La redencion del esclavo; Discursos parlamentarios; Historia del movieniento republicano en Europa; Ensayos literarios.

LIST OF GENERAL ARTICLES AND WORKS.

Diercks: Das Moderne Geistesleben Spaniens, Leipzig, 1883.
Hubbard: Histoire de la Litterature Contemporaine en Espagne, Paris, 1876.
L'Etat Moral et Politique de l'Espagne, par L. Louis-Lande. (R. des Deux Mondes, tome XLI, p. 753, 1880).
Une Restauration: L'Espagne Sous Alphonse XII, par Anatole Leroy-Beaulieu, (R. des Deux Mondes. tome XXI, p. 241, 1877).
Gaffarel: Le Congrès Américaniste de Madrid. (Revue Politique et Littéraire du 5 Nov., 1881).
De Olias: Politicos Contemporaneos; Castelar. Madrid, 1877.
Discursos leidos ante la Real Academia Española en la pública recepcion del doctor Don Marcelino Menéndez Pelayo el dia 6 de Marzo de 1881. (Revue Critique, tome XI, p. 313, 1881).
Pelayo: Filosofia Heterodoxa y su influencia en la literatura. Libro VIII, cap. III, de la "Historia de los Heterodoxos Españoles," tome III. Madrid, 1881.

MR. A. M. ELLIOTT, Associate Professor of the Romance Languages, seven lectures on *Camoens*, the epic poet of Portugal, as follows:

I and II. *Tuesday, November* 25; *Thursday, December* 4. Preliminary Sketch of Portuguese History to the Death of Camoens (1580).

SYNOPSIS.

Warlike character of the old Lusitanians; battle of Ourique (1139); birth of the Portuguese monarchy; University of Lisbon founded (1284); Moorish power crushed at the memorable battle of Tarifa (1340); murder of Inez de Castro; John the Bastard, "*da boa memoria,*" second founder of the Portuguese monarchy; battle of Aljubarrota (1385), "which was to the Castilian what Ourique had been to the Moor"; "The Twelve of England"; Da Gama and the discovery of India (1498); Almeida, the first viceroy of India; the "terrible Albuquerque, Primus in Asia, Cæsar in Portugal"; "Goa the Golden"; Birth of Camoens (1524); culmination of Portugal's fame; discovery of Brazil; John de Castro, consolidator of the Portuguese Empire in the East; Don Sebastian; failure of "the universal idea"; corruption of the Lieges; battle of Alcacerquiver (1578); downfall of Portugal in the East; Philip II of Spain and the "sixty years captivity" of Portugal; death of Camoens.

III. *Tuesday, December* 9. Life of Camoens (1524–1580).

CHRONOLOGY.

1537, enters college at Coimbra;
1542, visits the royal court at Lisbon;
1546, enamored of Catherina d'Athayde; first banishment;
1547, sent to Ceuta (Africa), second banishment;
1553, sails to India in the ship *San Bento*, third banishment;
1556, sent to China (Macao), fourth banishment; Catherina dies in Lisbon;
1558, returns to India (Goa); is shipwrecked off the coast of Cambodia, saving only his poem The Lusiads; hears of the death of Catherina on his arrival at Goa;
1567, accompanies Barreto, the governor of Mozambique, to Sofala; is found there in great destitution;
1569, 1570, returns to Lisbon; presents the MS. of The Lusiads to the king, Don Sebastian, to whom the poem is dedicated;
1572, Editio princeps of The Lusiads;
1578, the drama of Alcacerquiver;
1580, first translation (Castilian) of The Lusiads by Benito Caldera; death of the poet in a hospital at Lisbon.

IV. *Thursday, December* 11. Minor Works of Camoens.

The Rimas and Dramas of Camoens in their relation to the Lusiads, comparison of the Rimas of Camoens with those of Petrarch; the Camoens sonnet compared to that of Boscan and Garcilaso de la Vega, the renovators of the sonnet in Spain; characteristics of Camoens' Cançons, Elegies, and Odes; Italian style followed in all these species of verse; in his dramatic works he follows the peculiar style of his country; exquisite beauty of the poems dedicated to Dona Catherina; extracts.

V and VI. *Tuesday, December* 16; *Thursday, December* 18. The Lusiads.

The subject of this poem the most memorable achievement in Portuguese history—the discovery of India by Da Gama; the Lusiads "The Epos of Commerce," an epic national picture of Portuguese glory; machinery and action of the poem; the Lusiads the first epopoeia of modern literature; chief characteristics of Camoens' poetry; Camoens compared with Dante, Tasso, and Ariosto; the episodes, their strongly marked dramatic interest; Camoens' descriptions of nature; his patriotism; his powerful personality.

The following episodes are of special interest:

I. Council of deities on Olympus i, 20–40; II. Interviews of Jupiter and Venus, ii, 33–43 (Venus appeals to Jupiter on behalf of the Lusians); III. The Maria-Mission, iii, 101–6, the "lovely Maria" (Queen of Spain) asks succor from her father, D. Alfonso IV, King of Portugal; *IV. Inez de Castro, iii, 119–135 (preferred by La Harpe to anything in the Paradise Lost of Milton); V. The Dream of D. Manoel, iv, 66–75; VI. The old man's fare-

ate a large body of literature in themselves. Many of them were
anted to the soil of the North more than two hundred years ago,
rittany and Normandy, and represent that common genus of min-
or folk-song, so frequently found in North Spain, Provence, France,
any others, again, are of native growth, illustrating themes of popu-
pathy or individual experience in the history of the early settlers.
re more than in Canada does this species of literary composition
serve the important purpose of strengthening a feeling of common
t and fortifying the national spirit, and in the full consciousness of
ving power the leaders of this people to-day may well accept the
sm of old Fletcher: "Give me the making of songs for the people
are not who makes the laws."

oint of language the Canadian French is certainly one of the most
ting topics for a philologian. Here we find that time has stood still,
lly for the more remote rural districts, and the scholar could easily
e himself holding intercourse with the subjects of Louis XIV. This
that we have the unique privilege in this age of steam and travel of
g in them a form of speech that has scarcely known change for the
o centuries. But this idiom is not a dialect of that remote period, and
atest surprise to a student of language arriving in Canada is to find
ontrary to the general impression of scholars, the vernacular does not
ny specific dialectic character, but is the Middle (sixteenth century)
with those natural changes which would be produced by the inti-
usion into a whole of all the different species of language that were
lly brought from the mother country. The commonest *Habitant*
tands French and the stranger will easily follow him in conversation,
ed he knows the terms and forms of the old language. The next
eneral characteristic of this striking type of speech is the colorless
mity of pronunciation referred to above. Displacement of accent
), the sonant character of final consonants, especially the *t* in proper
(Nicolet); the imperfect articulation of the *r*—all these are more or
ticeable everywhere and are doubtless due to the influence of contact
he English. The further general syncopation of *emutum*, as in *j'f'ra,*
'nez and the extensive application of the "Law of Least Action" in
contractions, such as *j' m' a* (*a* in English *father*) for *je m'en vais* are
n and make the language, for a short time, rather difficult to be
tood by the uninitiated.

the Phonetics the most notable deviation from the modern French
is found in the variety of sound-shading given to one and the same
c sign where the Parisian often has but one or at most two species to
s. This holds true for the vowel, and more particularly for the diph-
; for example, in the *oi* and *eu* combinations. In both of these we
hree distinct nuances of sound, namely, for the former, 1, *oi* = *ea* in
h *wear, swear;* 2, *oi* = French *oé* (*moé*); 3, *oi* = the abnormal modern
h *wa*; for the latter, 1, *eu* = the ordinary French phonetic equivalent
an *ö*); 2, *eu* = simple French *u* (German *ü*); 3, *eu* = a sound mid-
etween these two and which I designate by *ü*. The *a*, too, gives us
distinct kinds, viz: 1, *a* = *a* in English *all*; 2, *a* = *a* in English *father;*
the common flattened French *a*. The Norman *ar* for *er* (*travarser,*
t, etc.,) is universal, and the strengthening of *i* to *a* most common, *e. g.*,
(shilling), *Ballé* (Billy), etc.

the consonants the palatalization of the guttural mutes is one of the
d most striking peculiarities that a stranger is likely to notice; for
le, *trankjille* (tranquille), *kjeu* (queue), *vainkjeur* (vainqueur). Cf. Vir-
kjar (car), *gjirl* (girl). Again, the interchange of palatalized *t* and *k*
noikjé (moitié), and the substitution of the former for simple guttural
as in *tjuré* (curé); or the replacing of simple dental by palatalized
al, *e. g.*, *kjuer* (tuer). The syncopation of a palatalized dental sonant
e development afterwards of the palatal vowel into its corresponding
owel state is found everywhere, as in *Canayen* (Canadian). *R* fre-
ly undergoes the same vocalization, *e. g.*, *cayottes* (*carottes*). Pros-
, epenthetical and epithetical elements abound, especially for strong
s, as in *tsour* (*sous*), *tsur* (*sur*), *i n'y a t officiers*, *léjart* (*une voiture léjart*).
morphology gives us more interesting examples of Folk-treatment,
example, the article *il* = *i*, *ils* = *iz*; all adjectives in *if* are invariable
emme vif); the numerals ending in *s* have feminine forms (*troises*
); all new creations of verbs on English stems are thrown into the
jugation, *e. g.*, in *bit-er* (beat), *scrép-er* (scrape), *slak-er* (to slack),
r (log) = to roll logs together, while in the formative period of
French those hybrid compounds were distributed between the *A*-and *I*-forms, as is seen in modern French *garnir* (= *A. S. varnian*); Old French *gandir* (=Goth. *vandjan*). Among the older inhabitants especially we hear *j'avions*, *j'étions*, etc., similar to the custom of verb-usage in rural districts of France.

For the syntax I will note here only one general characteristic, that is, the universal omission of the real negative particle in the combination *ne-pas*, *e. g.*, *j'pense pas* (for *ne pense pas*), *j'aime pas*, etc. This phenomenon is interesting in that it simply carries one degree further the tendency of the classical language to make the Latin *passus* share the burden of negation with its legitimate representative *ne*. The supplementary particle finally comes to take the place of the primitive element altogether. Old French words and expressions are naturally found everywhere in the greatest abundance and original French terms, with special uses peculiar to the Canadians, are numerous. Among the latter we may cite *cailler* = *s'en dormir*, *butin* = Norman for "clothes", *mouiller* (taking effect for cause) = *pleuvoir*, *poudr-er* (from *poudre*) = to snow a fine, mealy snow; *embarquer*, *débarquer*, for *monter*, and *descendre* with reference to a vehicle, *mouver* = "to move household effects," etc., etc. But it is not alone old words and new uses of modern terms that meet us here. The special formations in Canadian French are very extensive and often serve to show how the classical language was probably built up by adding one analytic product to another. From the Latin *quasi* we have the adverb *casiment*, and so, too, from the modern French *presque* (*pressum quod*), the Canadian, in generalizing his adverbial categories, produces *presquement*. After the manner of the early creations in the language he has no scruple in producing a simple verb *venter* = "to blow" (used of wind) from the substantive *vent* and from *gens* he strikes out *engenser* in the same mould which his ancestors used for the production of similar verbal parasynthetics with the relational *en*.

Following again in the footsteps of the early makers of his language in adapting Latin flexions to Gothic and German stems, he says, *sidez les chars* (= to run cars off the main on to the side track of a railroad), *le cheval a bolté* (= "the horse bolted"), *blackballer*, etc., etc. It is, however, in the province of proper names where we find to-day the most extraordinary phenomenon, perhaps, in the whole range of creations with which the French Canadian has enriched his native tongue. We are so accustomed to think the supply of material sufficient for the demand in this department of word-formation and, therefore, the name-book has been closed, that we can scarcely believe the evidence of our senses when we suddenly face a people with whom the process of proper-name creation is in full force and of daily occurrence. Such is the case in Canada. A single example will suffice to illustrate one phase of this procedure. Monsieur Guérin has two sons named, respectively, Charles and Jacques. The former is a special favorite of his father and receives the soubriquet *la joie*, that is, Charles Guérin dit La Joie. As said Charles grows up he drops entirely the name of his father (Guérin) and is only known as Monsieur Charles La Joie, his brother all the time continuing to bear the original designation of his father's family. It thus constantly happens that two persons or two households most closely connected in blood relationship have wholly different names, and these new soubriquets serve again in their turn for the production of other appellations.

In the above *résumé* I have tried to give simply a few salient points along the line of investigation which I have followed in collecting material for a scientific treatment of the Canadian French language. I hope in a few months to begin to publish the results of my work.

Mr. Mendes Cohen on "the Cohen Collection of Egyptian Antiquities," and its Collector, Colonel Mendes I. Cohen.

[Read at a meeting of the University Archæological Society, November, 1884].

In view of the recent transfer to the Johns Hopkins University of the collection of Egyptian Antiquities, formed by Colonel Mendes I. Cohen, and from which we have a few objects before us to-night, it has been thought fitting by the president of the University, that I should present a few notes in regard to the collector, and briefly narrate how it came about that there should have been gathered here the ancient relics, which for the

ANNOUNCEMENTS.

Appointment of Professor Newcomb.

At a meeting of the Trustees, October 6, 1884, Professor **Simon Newcomb**, LL. D. (Foreign Member of the Royal Society, and Corresponding Member of the Institute of France), of Washington, Superintendent of the American Ephemeris and Nautical Almanac, was invited to succeed Professor Sylvester, under the title of Professor of Mathematics and Astronomy in the Johns Hopkins University. This appointment he has accepted and has already entered upon his duties. Professor Newcomb has been more or less associated with the University since its origin. He was one of the first to receive the appointment of a Lecturer, he was announced as one of the original associate editors of the American Journal of Mathematics, to which he has occasionally been a contributor, and he has acted as an Examiner in Mathematics. The subjects of his principal scientific memoirs are:—on the Secular Variations, etc., of the Asteroids; investigations of the Motions of the Moon; the Theories of the Planetary Motion; Tables of Neptune and Uranus; etc.

He has also been a frequent contributor to the magazines on political economy and on the progress of science.

The American Journal of Mathematics begins its seventh volume with Professor Newcomb as Editor, and Associate Professor Craig, as Associate Editor.

Honorary Hopkins Scholarships.

The Trustees, on the recommendation of the Board of Collegiate Advisers, who superintended the examination, conferred, on October 6, Honorary Hopkins Scholarships on the following undergraduate and matriculated students:

Edward Carey Applegarth, of Baltimore,
Jay Cæsar Guggenheimer, of Baltimore,
Theodore Hough, of Virginia,
John Hanson Thomas McPherson, of Baltimore,
Edward Lucas White, of Baltimore.

Graduate Scholarships.

The following appointments to Graduate Scholarships which were made by the Trustees, on the nomination of the Academic Council, June 2, 1884, have not hitherto been publicly announced:—

William S. Bayley,
David Barcroft,
Albert E. Egge,
William L. Glenn,
George T. Kemp,
Gonzalez Lodge,
Moses Slaughter.

The following were appointed by the Trustees on October 6, 1884:—

Davis R. Dewey,
Charles B. Wright.

Fellowships.

Gustav Bissing, A. B., has resigned his Fellowship in Mathematics, to accept a position as one of the examiners in the U. S. Patent Office, Washington.

Albert H. Tolman, A. B., has resigned his Fellowship in English, to accept the position of Professor of English Literature and Rhetoric in Ripon College, Wisconsin.

James R. Duggan, Ph. D., has resigned his Fellowship in Chemistry, in order to be free to engage in certain chemical work not quite compatible with his duties as a Fellow.

The vacant fellowship in Philosophy was assigned by the Trustees, October 6, at the recommendation of the Academic Council, to **William Noyes, Jr.**, A. B., Harvard, 1881.

Note as to Tuition for Special Courses in History, Etc.

The Trustees have decided:—

That the fee for the two courses in the "History of Politics" and "Finance and Taxation" be $20 per annum for both; and for any other undergraduate courses in the Historical Group which occupy five hours weekly, $20 per annum;

That a fee of $20 be expected from those who join the Seminary only;

That these fees be payable in advance, $10 per half-year.

Course of Lectures to Graduate Students.

The second annual course of **Educational Lectures** by various members of the Faculty was begun with a lecture by President Gilman on Academic Degrees, on Saturday, November 15, at 10 a. m., in Hopkins Hall. A second lecture was given by Professor Hall on Student Life, on November 22.

This course will comprise about twelve lectures and, like that of last year, is designed only for graduate students, who are invited to attend. Special registration in a book provided at the office, and special cards of admission are requisite.

Lectures have been promised by the following persons, on the subjects named,—the dates to be fixed hereafter.

S. Newcomb. Mathematics and education.
J. Rendel Harris. On the study of ancient MSS.
W. K. Brooks. The zoölogical significance of education.
M. Warren. Application of the historical method to the study of Latin.
R. T. Ely. Educational value of political economy.
M. Bloomfield. Method of comparative philology as pursued to-day.
E. M. Hartwell. Physical training in American colleges.
A. M. Elliott. Methods in the study of modern languages.
W. E. Story. Methods of teaching arithmetic.
T. Craig. Mathematical teaching in France.

Formation of a Shakespeare Circle.

In order to encourage the study of Shakespeare in this University, during the current year, among all the students, in science as well as in literature, a **Shakespeare Circle** has been formed under the general guidance of Dr. Browne and Dr. Wood. The members of the Circle will receive special aid and encouragement in this study. They will have the privilege of attending not only Mr. Corson's lectures, but also other less formal conferences and meetings, in which various Shakespeare scholars will take part.

All members of the University who wish to join this Circle, may inscribe their names in a book at the Registrar's office and receive a card of membership.

The first meeting was held Monday, November 24, when the plan of the winter's work was made known, and hints were given in respect to good methods of study, adapted to the members of the Circle.

Formation of an Art Circle.

Under the auspices of the Archæological Society of the Johns Hopkins University, it is proposed to form an **Art Circle** to develop an interest in Art and Archæology. All students, those of the scientific and literary, as well as those of the historical, philosophical and classical classes are invited to join.

On entering their names in the book kept for the purpose at the Registrar's office, they will receive the card of membership.

The Circle will hold frequent meetings at 106 West Monument street, under the direction of members of the Archæological Society, either for the informal study of works of art on exhibition, or for the consideration of some interesting art-topic.

The members of the Circle will have the right to attend the art loan exhibitions during the term, as well as the meetings of the University Archæological Society.

Notice of the Matriculates' Literary Society.

Under the auspices of the Matriculate Society of the University, a **Literary Society** was organized last year, which had for its object the promotion of literary exercises of all kinds. The society was organized by matriculates, but its membership already includes a number of graduate students. The Society's Committee asks the coöperation and aid of all students to make successful the efforts of the society during this, its second year of existence; and for that purpose requests their presence, when possible, and contributions to the exercises of the society. Essays, addresses, and the like are desired, and in the regular debates any persons present are requested to take part.

found themselves enabled to effect its transfer to the University. Here it finds a permanent abiding place, and whilst as the "Cohen Collection" it serves as a memento of the taste and zeal of an untiring traveller, it becomes an ornament to the Institution which now possesses it, and will prove we trust an invaluable aid to the student of Egyptian History and Art.

On the Number of Substitutions of *n* Letters which leave *k* Letters Unaltered. By W. P. DURFEE.

[Abstract of a paper read at the May meeting of the University Mathematical Society].

Denote this number by $[n, n-k]$. If we leave any k specified letters unaltered the number of substitutions satisfying the condition will evidently be $[n-k, n-k]$, and since these k letters may be chosen in $\frac{n!}{(n-k)!\,k!}$ different ways we have

$$[n, n-k] = \frac{n!}{(n-k)!\,k!}\,[n-k, n-k].$$

Now $[m, m]$, which is the number of permutations of m letters in which no letter occupies its original place, is known to be equal to $m!\sum_{n=0}^{n=m}(-)^n\frac{1}{n!}$ We have then

$$[n, n-k] = \frac{n!}{k!}\sum_{n=0}^{n=n-k}(-)^n\frac{1}{n!}.$$

From this we easily deduce the formula of recursion,

$$[n, n-k] = (k+1)[n, n-(k+1)] + (-)^{n-k}\frac{n!}{(n-k)!\,k!}.$$

From $$[n, n] = n!\sum_{n=0}^{n=n}(-)^n\frac{1}{n!}$$

we obtain the formula

$$[n, n] = n\,[n-1, n-1] + (-1)^n$$

which readily reduces to

$$[n\,.\,n] = (n-1)\left\{\,[n-1, n-1] + [n-2, n-2]\,\right\}.$$

A Note on the Divisibility of Numbers. By W. P. DURFEE.

[Abstract of a paper read at the May meeting of the University Mathematical Society].

Let $a_\gamma = \gamma\ (\gamma = 1, 2 \ldots p-1)$ where p is a prime number. If we denote the simple symmetric functions by $s_1, s_2, \ldots, s_{p-1}$, we have from

$$x^{p-1} - 1 \equiv 0 \quad (\text{mod. } p).$$
$$s_1 \equiv s_2 \equiv s_3 \equiv \ldots \equiv s_{p-1} + 1 \equiv 0 \quad (\text{mod. } p).$$

Consider the symmetric function $\sum a_1^{a_1} a_2^{a_2} \ldots a_k^{a_k}$ where $a_1, a_2 \ldots a_k$ is the the n^{th} partition of n (the order of the function) in natural order.

If $n < p-1$ $\sum \equiv 0$ (mod. p) since $\sum = f(s_1 s_2 \ldots s_n)$.

If, however, $n = p-1$

$$\textstyle\sum \equiv \text{term in } s_{p-1} \equiv -\,\text{co}\ s_{p-1}\ (\text{mod. } p).$$

But by the theorem of symmetry (Betti. Tortilini, 1858), co s_{p-1} in the value of $\sum$ is equal to the coefficient of the corresponding function of the s's in the value $\sum a^{p-1}$, or say σ_{p-1}. If λ_1 of the a's are equal to 1, λ_2 of them to 2, etc., this function of the s's is $s_1^{\lambda_1} s_2^{\lambda_2} \cdots s_\pi^{\lambda_\pi}$ and we shall have

$$\textstyle\sum \equiv -\,\text{co}\left(s_1^{\lambda_1} s_2^{\lambda_2} \ldots s_\pi^{\lambda_\pi}\right) \text{ in the value of } \sigma_{p-1}$$
$$\equiv (-)^{\Sigma\lambda-1}\frac{(p-1)\,(\Sigma\lambda-1)!}{\lambda_1!\,\lambda_2!\ldots\lambda_\pi!}.\ (\text{mod. } p).$$

Dr. Franklin has pointed out to me that the same result may be reached, without using the theorem of symmetry, by considering $\sum = f(\sigma\text{'s})$.

CORRESPONDENCE AND NOTES.

Hermas and Theodotion; a communication from Professor Hort with regard to an emendation of the text of Hermas.

The note on the Angelology of Hermas printed by Professor Rendel Harris in the *Johns Hopkins University Circular* for April contains a discovery of considerable interest in itself, and further noteworthy as having at once enabled the discoverer to find a satisfactory answer to an old riddle. There cannot be a doubt that he is right in tracing back the language of Hermas in Vis., iv, 2–4, to Daniel, vi, 22; and it is hardly less certain, I think, that he has given the true explanation of *Θεγρί*, the mysterious name of the angel sent to protect Hermas, by reading it as *Σεγρί* taken as a derivative from *sagar*, the verb employed in that verse for the shutting of the lions' mouths.

The best known repositories of Jewish Angelology do not appear to contain the name of *Segri*: but *Sigron* (סגרון) is recorded by Levy-Fleischer (p. 478) from the Talmudic Tract Sanhedrin as an accessory name of Gabriel, given him "because, if he shuts the doors of heaven, no one can open them." The designation would seem to belong more naturally in the first instance to some such high function as this than to the shutting of lions' mouths —an office not to be confounded with the general charge of lions or other beasts, said to have been appropriated to different angels: and the occurrence of Gabriel's name in Dan. viii, 16: ix, 21 may easily have been taken as determining the identity of the angel of vi, 22. By what channel the Hebrew application of an obscure name belonging to Jewish tradition came to be accepted, though apparently misunderstood, by the Roman Hermas is a question easier to ask than to answer.

My chief purpose however in writing this supplementary note, which is sent by Professor Rendel Harris's request, is to point out that his discovery may have an important bearing on the disputed question of the Shepherd's date. The language of Hermas follows not the true Septuagint version of Daniel, but that of Theodotion, which superseded it in the course of the second century. The Septuagint drops the angel altogether; and in v, 22 has merely *σέσωκέν με ὁ θεὸς ἀπὸ τῶν λεόντων*, while it transfers the shutting of the lions' mouths to v. 18 by the insertion of an interpolated clause ending *ἀπέκλεισεν τὰ στόματα τῶν λεόντων καὶ οὐ παρηνόχλησαν τῷ Δανιήλ*. This clause, shortened in the opening words, was retained by Theodotion, with *ἔκλεισεν* (according to the best MSS.) substituted for *ἀπέκλεισεν*; but he corrected v. 22 by the Aramaic text reading *ὁ θεός μου ἀπέστειλεν τὸν ἄγγελον αὐτοῦ καὶ ἐνέφραξεν τὰ στόματα τῶν λεόντων καὶ οὐκ ἐλυμάναντό με*. Now Hermas has retained not only the angel, but the two characteristic Greek verbs, for he writes *ὁ κύριος ἀπέστειλεν τὸν ἄγγελον αὐτοῦ . . . καὶ ἐνέφραξεν τὸ στόμα αὐτοῦ ἵνα μή σε λυμάνῃ*.

It follows that Hermas cannot be earlier than Theodotion. To discuss the other evidence for the date of either Hermas or Theodotion would be beyond my present purpose.

CAMBRIDGE, ENGLAND, July 8, 1884. F. J. A. HORT.

Icaria: a Chapter in the History of Communism. By ALBERT SHAW, Ph.D., late Fellow in the Johns Hopkins University. (New York and London, G. P. Putnam's Sons, 1884, pp. 219, 16^mo.^)

This volume, which was accepted by the Johns Hopkins University as a thesis for the doctor's degree, is an attempt to present a careful history of a single communistic experiment. The author has felt that the most common defect of social and political science is the tendency to generalize too hastily; and he here offers us a study of communism in the concrete as found in Icaria. "I have endeavored," says Dr. Shaw, "to explain its origin, to follow the external facts of its checkered and generally unfortunate career, to picture its inner life as a miniature social and political organism, to show what are in actual experience the difficulties which a communistic society encounters, and to show by a series of pen-portraits what manner of men the enterprise has enlisted." The romantic and instructive history of Icaria is contained in eleven chapters, entitled: Étienne Cabet, the Founder of Icaria; Colonization in Texas; Communist Life at Nauvoo; the Cheltenham Episode; Pioneer Life in Iowa; The Sons versus the Fathers; Reorganization,—"The New Icarian Community;" "La Jeune Icarie;" in California—"Icaria Speranza;" "Personal Sketches;" "Some Kindred Social Experiments." An appendix contains a reprint of original documents, relating to the history of Icaria. B. T. E.

PROCEEDINGS OF SOCIETIES.

Scientific Association.

November 5.—Fifty-ninth regular meeting. Professor Martin in the chair. Fifty-one persons present.

Officers were elected for the ensuing year as follows:

Professor Martin, President; Professor Rowland, Vice-President; Dr. E. H. Keiser, Secretary; Committee on Papers, Professor Martin, Dr. Franklin, Mr. G. A. Liebig, Jr., Dr. Keiser, Dr. Brooks, and Mr. W. Noyes.

Papers read:

On Sir William Thomson's models to illustrate the theory of light, by H. A. Rowland.

On a New Theory of Variation, by W. K. Brooks. (*Abstract on p.* 14).

Recent Experiments on the Sense of Rhythm, by G. S. Hall.

Philological Association.

October 10. Fifty-sixth regular meeting. Professor Gildersleeve in the chair. Thirty-two members present.

Papers read:

On a Philological Expedition to Canada. by A. M. Elliott. (*Abstract on p.* 20).

On the Meaning of Baalim and Ashtaroth in the Old Testament, by A. L. Frothingham, Jr.

November 7.—Fifty-seventh regular meeting. Professor Gildersleeve in the chair. Thirty-nine members present.

Papers read:

On Petrarca's relations to the Universities of his time, by A. Emerson.

Two Etymological Notes, by M. Bloomfield.

Some Account of Belock's Speculation on the Financial History of Athens, by C. D. Morris.

On Weil's View of the Origin of the Word "Poet," by B. L. Gildersleeve.

Historical and Political Science Association.

October 3.—Dr. H. B. Adams in the chair.

Pullman, a Social Study, by R. T. Ely. (*To be published in Harper's Monthly.*)

The American Historical Association, by H. B. Adams.

October 10.—Dr. H. B. Adams in the chair.

Pennsylvania State Finance and Taxation, by T. K. Worthington.

Sources of information for the study of Slavery, by General William Birney.

October 17.—Dr. H. B. Adams in the chair.

The House of Representatives, Revenue and Supply, by Woodrow Wilson.

Review of Shaw's "Icaria," by D. R. Dewey.

October 24.—Dr. H. B. Adams in the chair.

Review of the seventh volume of the U. S. Census on "Valuation," by John C. Rose. (*Abstract published in The Nation, October* 30, 1884).

The Progress of Civil Service Reform in the United States, by H. B. Adams.

October 31.—Dr. H. B. Adams in the chair.

Land Laws of Mining Districts, by Charles Howard Shinn. (*Published in full in the "Historical Studies," Second Series, XII, December*, 1884).

The Government and Civil Service of China, by Dr. McCarthy, for many years a resident in China.

November 7.—Dr. H. B. Adams in the chair.

History of Witchcraft in Connecticut, by C. H. Levermore.

The House of Lords, by E. R. L. Gould.

November 14.—Dr. H. B. Adams in the chair.

City Government in Baltimore, by John C. Rose.

The proposed Revision of the City Charter of Boston, by H. B. Adams.

Archæological Society.

On November 19, the Archæological Society of the University held its opening meeting at 106 W. Monument street, where the rooms of the Society are now established.

Mr. M. Cohen read a paper on Col. M. I. Cohen, who made the valuable collection of Egyptian antiquities recently acquired by the University. (*See p.* 21.)

A communication was made by Professor Haupt on some remarkable early Chaldean antiquities lately purchased by Prof. A. Marquand, of Princeton.

Dr. Frothingham spoke on some Arabian and other antiquities belonging to the same collection.

Dr. Emerson called the attention of the Society to some interesting late works on the history of Greek Art.

Prof. Harris presented the photograph of the first lines of the "Teaching of the Twelve Apostles," proving it to be in the same hand as the preceding part of the MS.

On Saturday, November 22, there was opened at 106 Monument street, under the direction of the Archæological Society, an exhibition of original drawings, in red chalk, pen and ink, water colors and pencil, by old Italian masters, loaned from the collection of A. L. Frothingham, which was purchased by him in 1870 from the heirs of Prof. Angelini, of the Academy of Fine Arts of Bologna.

There are 85 drawings, of which 52 are by masters of the School of Bologna, extending over the period from Prospero Fontana (1512–1597), the precursor of the Caracci, who were the regenerators of the School, down to Gaetano Gandolfi (1734–1802), the last of the imitators of the Caracci. Besides the Caracci (Lodovico, Agostino and Annibale), it includes good examples of Guido Reni, Guercino, Franceschini, and Donato Creti.

The Roman School is represented by 14 examples, including Sodoma of Sienna (1479–1554), Pellegrino Tibaldi, the imitator of Michel Angelo, and the Scholars of Raphael, Polidoro da Caravaggio and Julio Romano: from Naples is a pen drawing by Josef Ribera, "Il Spagnoletto."

Of the schools of North Italy are notable drawings by Leonardo da Vinci of Milan (1452–1519), Correggio of Parma (1494–1534), Andrea Mantegna of Padua (1430–1506), Giorgione of Venice (1478-1511). There is an interesting example of Henricus Goltzius (1558–1617), who, though not a native, studied in Italy and was a true child of the Italian Renaissance.

A number of fragments of Roman and Pompeian sculptures from the same collection were also on exhibition. They form a part of some acquired in 1871 at Rome at the sale of the remnant of the famous collection of the Marquis Campana. Most of the pieces are fragments of sarcophagi belonging to the second and third centuries after Christ. Some are heads which adorned the corners of the lids, some are narrow reliefs from the front of these lids, while the greater portion belonged to the lower part of the sarcophagus.

Metaphysical Club.

November 18.—Thirty-ninth regular meeting. Professor Hall in the chair. Nineteen members present.

It was decided to discontinue the existing Metaphysical Club and after proceeding tentatively for a few meetings, to effect an organization which shall better satisfy the needs of those interested in this department.

Reports of readings were made:

On Fred. Kapp's Grundriss einer Philosophie der Technik and on du Prel's Philosophie der Mystik, by G. S. Morris.

On "The Magnet" a fourteenth century manuscript of Petrus Peregrinus, by C. S. Peirce.

On a series of Books on Ultra-Longevity, by J. Jastrow.

On Meynert's Psychiatrie, Radestock's Genie u. Wahnsinn, and Sully's Psychology, by G. S. Hall.

A discussion on psychical research closed the meeting.

Baltimore Naturalists' Field Club.

October 15.—Dr. Williams in the chair. Thirteen members present.

The following officers were elected for the year:

President, Dr. G. H. Williams; Secretary, Dr. W. H. Howell; Chairman of Zoölogical section, Mr. Lugger; Chairman of Botanical section, Mr. Donaldson; Chairman of Geological section, Dr. Williams.

October 16.—Special meeting. Dr. Williams in the chair. Twenty-three members present.

The new map of the region surrounding Baltimore published under the auspices of the Field Club, was exhibited and addresses in reference to it made by President Gilman, Dr. G. H. Williams, Mr. Uhler, Dr. B. W. Barton and Mr. G. L. Smith.

November 19.—Regular monthly meeting. Dr. G. H. Williams in the chair. Twenty members present.

Mr. Nelson read a note on the bark louse parasitic on the beech.

This louse is usually known as a coccus, but is probably an aphis. It has a peculiar brush-like appendage consisting of thin fragile white threads. These are composed of a substance allied to the wax secreted by bees and are a cellular secretion of epidermal glands, which in this insect are especially abundant on the dorsal side of the last four abdominal segments. In the coccus on the alder the secretion covers the whole of the back of the abdomen. The function of the secretion as far as known, is to keep the insect dry and warm. It is lost with the last moult and left clinging to the branches of the tree. No ant has been found near the colonies of the beech coccus. Neither oviparous females nor males were found in the beech coccus, but only winged viviparous females.

Mr. Donaldson of the Botanical section made a report of the field work for the past month and gave the plan of work to be adopted during the present year.

Mr. McMurrich addressed the club on the methods of collecting and studying parasitic fungi, describing the methods to be followed in tearing out, macerating and cutting sections of specimens, and the method of innoculation experiments.

Mr. C. S. Palmer reported the mineralogical work of the Geological section of the Field Club.

Brown tourmaline in good crystals and tremolite in fibrous masses had been recently found in the crystalline limestone of Texas, Balto. Co. The anthophyllite-like mineral occurring at the Mt. Washington copper mine had been chemically examined by Messrs. Palmer and Kastle, who found that it agreed with anthophyllite in containing no lime, although a very considerable amount of alumina was present. The optical properties of this mineral, as determined by Dr. Williams, are those of the monoclinic system; it appears therefore to be what Des Cloizeaux has called amphibole-anthophyllite.

American Institute of Archæology, Baltimore Branch.

A meeting of the Baltimore Branch of the Archæological Institute of America, was held November 17, at 106 W. Monument Street. By grouping around Baltimore the members of several States besides Maryland, a total membership of about fifty was reached, which entitled the branch to be represented by two members at the General Council of the Institute.

It was decided that Mr. McCoy's gift to the society of one hundred dollars should be given in the form of a life-membership in the Institute to whomever, being a resident in Baltimore, should present an archæological dissertation judged worthy of the prize. Professors Gildersleeve, Warren and Elliott were appointed a committee to arrange the details of the above proposal. Finally the secretaries, Drs. Emerson and Frothingham, were chosen members of the Council, which met in New York on November 20.

[Issued December 5, 1884.]

JOHNS HOPKINS
UNIVERSITY CIRCULARS

Published with the approbation of the Board of Trustees

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CALENDAR, 1884–85.

Tuesday, September 23.	**Current Academic Year Began.**
Tuesday, September 30.	**Instructions Resumed.**
Wednesday, December 24—Saturday, January 3.	**Christmas Recess.**
Monday, February 23.	**Commemoration Day.**
Friday, April 3—Monday, April 6 (inclusive.)	**Spring Recess.**
Monday, June 8.	**Examinations for Matriculation Begin.**
Friday, June 12.	**Term of Instruction Closes.**

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The Johns Hopkins University Circulars are printed by Messrs. JOHN MURPHY & CO., 182 West Baltimore Street, Baltimore, from whom single copies may be obtained. They may also be procured from Messrs. CUSHINGS & BAILEY, No. 262 West Baltimore Street, Baltimore.

STANDING ANNOUNCEMENTS.

JOHNS HOPKINS UNIVERSITY.

Opened for Instruction in 1876.

The Johns Hopkins University was founded by the munificence of a citizen of Baltimore, Johns Hopkins, who bequeathed the most of his large estate for the establishment of a University and a Hospital. It was intended that these institutions should coöperate in the promotion of medical education. The Hospital buildings are approaching completion.

The foundation of the University is a capital, in land and stocks, estimated in value at more than $3,000,000; the capital of the Hospital is not less in amount.

The University was incorporated under the laws of the State of Maryland, August 24, 1867. Power to confer degrees was granted by the Legislature in 1876.

Suitable buildings have been provided in Baltimore at the corner of Howard and Little Ross Sts., and are furnished with the necessary apparatus and books.

ACADEMIC STAFF, 1884–5.

DANIEL C. GILMAN, LL. D., *President of the University.*
J. J. SYLVESTER, F. R. S., D. C. L., *Professor (Emeritus) of Mathematics.*
BASIL L. GILDERSLEEVE, PH. D., LL. D., *Professor of Greek.*
G. STANLEY HALL, PH. D., *Professor of Psychology and Pedagogics.*
PAUL HAUPT, PH. D., *Professor of the Shemitic Languages.*
H. NEWELL MARTIN, DR. SC., A. M., *Professor of Biology and Director of the Biological Laboratory.*
CHARLES D. MORRIS, A. M., *Collegiate Professor of Latin and Greek.*
SIMON NEWCOMB, LL. D., *Professor of Mathematics and Astronomy.*
IRA REMSEN, M. D., PH. D., *Professor of Chemistry and Director of the Chemical Laboratory.*
HENRY A. ROWLAND, PH. D., *Professor of Physics and Director of the Physical Laboratory.*
WILLIAM H. WELCH, M. D., *Professor of Pathology.*
JOHN S. BILLINGS, M. D., *Lecturer on Hygiene.*
HIRAM CORSON, A. M., LL. D., *Lecturer on English Literature.*
EDMUND GOSSE, *Lecturer on English Literature.*
GEORGE S. MORRIS, A. M., PH. D., *Lecturer on the History of Philosophy.*
LÉONCE RABILLON, BACH. ÈS LETT., *Lecturer on French Literature.*
WILLIAM THOMSON, LL. D., *Lecturer on Molecular Dynamics.*
HERBERT B. ADAMS, PH. D., *Associate Professor of History.*
MAURICE BLOOMFIELD, PH. D., *Associate Professor of Sanskrit.*
WILLIAM K. BROOKS, PH. D., *Associate Professor of Morphology and Director of the Chesapeake Zoölogical Laboratory.*
THOMAS CRAIG, PH. D., *Associate Professor of Applied Mathematics.*
A. MARSHALL ELLIOTT, A. M., *Associate Professor of Romance Languages.*
J. RENDEL HARRIS, A. M., *Associate Professor of New Testament Greek and Palaeography.*
HARMON N. MORSE, PH. D., *Associate Professor of Chemistry and Sub-Director of the Chemical Laboratory.*
WILLIAM E. STORY, PH. D., *Associate Professor of Mathematics.*
MINTON WARREN, PH. D., *Associate Professor of Latin.*
WILLIAM HAND BROWNE, M. D., *Librarian and Associate in English.*
WILLIAM T. COUNCILMAN, M. D., *Associate in Pathology.*
RICHARD T. ELY, PH. D., *Associate in Political Economy.*
FABIAN FRANKLIN, PH. D., *Associate in Mathematics.*
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J. FRANKLIN JAMESON, PH. D., *Associate in History.*
ARTHUR L. KIMBALL, PH. D., *Associate in Physics.*
PHILIP R. UHLER, *Associate in Natural History.*
GEORGE H. WILLIAMS, PH. D., *Associate in Mineralogy.*
HENRY WOOD, PH. D., *Associate in German.*
CHARLES F. RADDATZ, *Examiner in German.*
HUGH NEWELL, *Instructor in Drawing.*
EDWARD H. SPIEKER, PH. D., *Instructor in Latin and Greek.*
HENRY A. TODD, A. B., *Instructor in Romance Languages.*
CHARLES L. WOODWORTH, JR., *Instructor in Elocution.*
ALFRED EMERSON, PH. D., *Instructor in Classical Archæology.*
GEORGE HEMPL, A. B., *Assistant in German.*
WILLIAM H. HOWELL, PH. D., *Assistant in Biology.*
EDWARD H. KEISER, PH. D., *Assistant in Chemistry.*
CHARLES A. PERKINS, PH. D., *Assistant in Physics.*
OTTO LUGGER, *Curator of the Biological Museum*

PLAN OF THE CIRCULARS.

The Johns Hopkins University Circulars are published at convenient intervals during the academic year for the purpose of communicating intelligence to the various members of the University in respect to work which is here in progress, as well as for the purpose of promulgating official announcements from the governing and teaching bodies. During the current academic year, successive circulars may be expected in the months of November, December, January, February, March, April, May, and June, to be followed at the close of the year by an index.

Although these circulars are designed for the members of the University, they have frequently been called for by institutions and libraries at a distance, and also by individuals who are interested in the literary and scientific activity of this University. Subscriptions and exchanges are therefore received.

TERMS OF SUBSCRIPTION.

For the current year, 1884–5, $1.

For the year 1883–4, (140 pp. in cloth covers), $1.50.

For the year 1882–3, (156 pp. in cloth covers), $3.

For the years 1880–2, (250 pp. in cloth covers), $5.

Subscribers to the Circulars will also receive the Annual Register and Report of the University.

All subscriptions should be addressed to the "Publication Agency of the Johns Hopkins University."

Communications for the Circulars should be sent in prior to the first day of the month in which they are expected to appear.

PUBLIC LECTURES.

Notice in Respect to the Admission of the Public.

In answer to inquiries, and in correction of some current misapprehensions, the following statements are made in respect to the public lectures given in the Johns Hopkins University.

These courses are academic lectures, designed primarily for the members of the University, and supplementary to the regular class-room work of the students.

As the members of the University rarely require the entire room, the Trustees have taken great pleasure in inviting other persons, not connected with the University, to attend.

As these lectures are not intended for popular entertainment, but for the instruction of students, those persons first receive tickets, in most cases, who are known to be especially interested in a particular course,—ladies as well as gentlemen.

There is no general course ticket issued. Applications should state specifically the course for which tickets are desired. Programmes and other current information pertinent to university work may be found in the *University Circulars*, sent to subscribers on the payment of one dollar per annum, by the Publication Agency of the University.

The usage of giving personal notification has been discontinued, and those therefore who are interested in such announcements should hereafter consult the *Circulars*.

It will save much delay if applications for tickets and inquiries on these and other routine matters are addressed not to individuals but to the JOHNS HOPKINS UNIVERSITY, *by postal card*, and answers will be promptly returned by mail. Personal applications consume time needlessly.

☞ The lectures begin at 5 o'clock *punctually.* The doors of the hall are opened at fifteen minutes before 5, and the lectures do not exceed an hour in the delivery.

PUBLICATIONS ISSUED UNDER THE AUSPICES OF THE UNIVERSITY.

I. American Journal of Mathematics.

The publication of this journal commenced in 1878, under the editorial direction of Professor Sylvester, and is now conducted by Professor Simon Newcomb as Editor, and Dr. T. Craig as Associate Editor. Six volumes of about 400 pages each have been issued, and the seventh is in progress. It appears quarterly, in the quarto form. Subscription $5 per year. Single numbers $1.50.

II. American Chemical Journal.

This journal was commenced in 1879, with Professor Remsen as editor. Five volumes of about 450 pages each have been issued, and the sixth is in progress. It appears bi-monthly. Subscription $3 per year. Single numbers 50 cts.

III. American Journal of Philology.

The publication of this journal commenced in 1880, under the editorial direction of Professor Gildersleeve. Four volumes of about 570 pages each have been issued, and the fifth is in progress. It appears four times yearly. Subscription $3 per volume. Single numbers $1.00.

IV. Studies from the Biological Laboratory.

[*Including the Chesapeake Zoölogical Laboratory.*]

The publication of these papers commenced in 1879, under the direction of Professor Martin, with the assistance of Dr. W. K. Brooks. Two volumes of about 500 pages, octavo, and 40 plates each, have been issued, and the third is in progress.

V. Studies in Historical and Political Science.

The publication of these papers was begun in 1882, under the editorial direction of Dr. H. B. Adams. A first series of 470 pages and a second of 630 pages are now completed and a third series is in progress. Subscription $3 per volume.

The following publications are also issued by the University:

The UNIVERSITY CIRCULARS. Subscription $1 per year.

The ANNUAL REPORT presented by the President to the Board of Trustees reviewing the operations of the University during the past academic year.

The ANNUAL REGISTER giving the list of officers and students and stating the regulations of the University. Published at the close of the academic year.

The University Circulars, Annual Report, and Annual Register will be sent by mail for one dollar per annum.

All communications in respect to these publications should be addressed to the "Publication Agency of the Johns Hopkins University," Baltimore, Maryland.

In addition to the serials above named, a few copies are for sale of the papers named below:

STUDIES IN LOGIC. By members of the Johns Hopkins University. C. S. Peirce, Editor. (Boston: Little, Brown & Co.) 1883. 123 pp., 12o. $2.

THE DEVELOPMENT AND PROPAGATION OF THE OYSTER IN MARYLAND By W. K. Brooks. 1884. 193 pp., 4o. 13 plates and 3 maps. $5.

ON THE MECHANICAL EQUIVALENT OF HEAT. By H. A. Rowland. 1880. 127 pp., 8o. $1.50.

NEW TESTAMENT AUTOGRAPHS. By J. Rendel Harris. 1882. 54 pp., 8o. 4 plates. 50 cents.

SIR WILLIAM THOMSON'S LECTURES ON MOLECULAR DYNAMICS. Delivered at the Johns Hopkins University in October, 1884. Reproduced from stenographic notes by the papyrograph plate process. 370 pp., 4to. $5.00.

The officers for the current term are the following: *President:* Theo. Hough. *Vice-President:* A. L. Lamb. *Secretary:* H. M. Brune. *Executive Committee:* Langdon Williams, *Chairman;* C. E. Coates, Theo. Hough, H. O. Thompson, Allan C. Woods.

The meetings are held at the rooms of the Matriculate Society, 111 W. Monument street, at 8 p. m., on alternate Mondays.

LOAN EXHIBITION OF DRAWINGS, ETC.

By the liberality of A. L. Frothingham, Esq., a large number of original drawings by early Italian masters, chiefly of Bologna, and some interesting marble fragments, bought from the Campana collection, were placed on exhibition in the rooms at 106 Monument street. Some other interesting archæological relics have also been exhibited in the same house. This will be followed by periodical exhibitions of engravings, photographs and antiquities. The arrangements are under the auspices of the Archæological Society of the University. (*See p.* 28 *of this Circular*). The rooms are open Saturdays from 2 p. m., till dark.

The autumn meeting of the American Oriental Society (Prof. W. D. Whitney, President; Prof. C. R. Lanman, Secretary), was held in Hopkins Hall, Wednesday and Thursday, October 29, 30.

The annual session of the American Academy of Medicine (Dr. Benjamin Lee, President) was held in Hopkins Hall, Tuesday and Wednesday, October 28, 29.

The graduate students and their friends were invited to a reception in the Biological Laboratory, Monday evening, December 1, 1884.

NOTE RESPECTING THE EXCURSION MAP OF BALTIMORE, PUBLISHED BY THE JOHNS HOPKINS UNIVERSITY.

This map of Baltimore and its vicinity is intended primarily for the convenience of members of the Johns Hopkins University Field Club and such other students as may be desirous of investigating the natural history or exploring the natural beauties of this neighborhood. It is hoped that it will also prove a useful guide to other citizens of Baltimore whose walks or drives may lead them into the adjoining country.

The map is not to be regarded as complete or final in any respect, but only as the first step toward the attainment of a really good representation of the region. In the preparation of this first edition there has been no fresh survey; only the data already published have been compiled. These materials are more or less defective or inaccurate, and it is earnestly requested that all persons using the map, whether members of the University or not, make suggestions as to its improvement. It is proposed to publish new editions from time to time, upon which it is very desirable to embody all available new information or corrections concerning roads, paths, accurately determined elevations, important local names, etc., etc. Such information, as well as suggestions relative to the improvement of the general character of the map, are therefore solicited and may be sent in writing, with a signature, to the Field Club, at the office of the Johns Hopkins University.

For the purpose of additional convenience in its use the map has been ruled into squares of one mile each, the lines being lettered at the top and bottom and numbered at the sides for easy reference. Time tables of such lines of street cars as run from the city for a considerable distance into the country may be found in the Baltimore Directory.

A few copies of the map are for sale at Messrs. Cushings & Bailey, Messrs. J. Murphy & Co., and at the University. Price, $1.00.

SIR WM. THOMSON'S LECTURES AT THE JOHNS HOPKINS UNIVERSITY.

ANNOUNCEMENT OF PUBLICATION.

By invitation of the Johns Hopkins University, SIR WILLIAM THOMSON, LL. D., F. R. S. L. and E., Professor of Natural Philosophy in the University of Glasgow, Scotland, gave a course of eighteen lectures, on Molecular Dynamics, before the physicists of the University, in October, 1884.

Stenographic notes were taken by Mr. A. S. Hathaway, B. S., Cornell University, lately a Mathematical Fellow of the Johns Hopkins University, and these notes (with additions subsequently made by the lecturer) have been carefully reproduced by the Papyrograph Plate Process. A bibliography of the subjects considered will also be given with the lectures. In all there will be about 350 pages, quarto.

A few copies are offered for sale at $5.00 net. The edition is strictly limited to 300 copies, and orders should therefore be sent at once to the *Publication Agency of the Johns Hopkins University, Baltimore, Md., U. S. A.*

Copies may also be procured from Messrs. Mayer & Müller, W. Französische Strasse 38, Berlin; A. Hermann, 8 Rue de la Sorbonne, Paris; Trübner & Co., 57 Ludgate Hill, London.

The following notice of the lectures is reprinted from *Science*, November 7, 1884:

The title 'Molecular dynamics' does not give an accurate idea of the nature of Sir William Thomson's recent course of lectures at the Johns Hopkins university. The object of the lectures was to consider the possibility of placing the wave-theory of light upon a perfectly tangible physical basis which should be sufficient to account for all the phenomena. The lecturer stated at the outset that he would be occupied more with pointing out difficulties than with removing them. He expressed the conviction that what takes place in the propagation of light — at least through gases, if not through solids and liquids—can be represented in its essential features by supposing a mass of vastly denser matter in the ether, bounded by a perfectly rigid shell; this shell surrounded at a small interval by another perfectly rigid spherical shell; and so on. Each shell is connected with the one outside it by a number of spiral springs: the precise number of the shells is not a vital matter in the theory, and the actual number may be infinite, i.e., the system of shells may constitute a continuous atmosphere to the molecule. The problem of the modes of vibration of this system is essentially the same as that of a system of particles connected by springs in a straight line. As for the ether itself, it is to be considered as a substance which may not be an elastic solid, but which, so far as the luminiferous vibrations are concerned, moves as if it were an elastic solid. The lecturer carried on the mathematical discussion of these two dynamical problems—the propagation of waves in an elastic solid, and the motion of a system of spring-connected particles in a straight line—side by side, usually devoting the first half of a lecture to one problem, and the remainder to the other.

It is impossible here to give any specific account of the contents of the lectures; it may be stated, however, that many of the cardinal phenomena of light were shown to be explicable by the hypothesis sketched above, but that the phenomenon of double refraction presented apparently insuperable difficulties, as it has done in all previous attempts to explain it. By proper suppositions regarding the elasticity of the springs (in the mechanical 'model' of the phenomenon given above) double refraction would indeed be produced; but its law would be widely different from that actually observed.

The lecturer was conversational in his manner, made almost no use of notes, and was full of enthusiasm for his subject. The audience was composed of professors of physics from eastern and western colleges, scientific men from Washington, and students and instructors of the Johns Hopkins university. The lectures, while not condensed in form, presupposed thorough familiarity with the physical and mathematical theories involved. A verbatim report of them, from stenographic notes, will be issued in a limited edition, by the use of the papyrograph process. At the close of the course, Sir William Thomson was presented by the class with one of Rowland's concave gratings, as a memento of their connection with him.

PHILOLOGICAL ASSOCIATION.

Some account of King Alfred's Anglo-Saxon version of the *de Consolatione Philosophiae* of Boethius. By J. W. Bright.

[Read at the meeting of the University Philological Association, December 5, 1884].

The aim of this paper was to give a full and critical account of the manuscripts and the editions of this Anglo-Saxon text; to consider the relation of the MSS. to each other, and to their ultimate sources; and to indicate the lines of inquiry to be pursued in investigating the question of the authorship of the meters.

The history of the MS. Cott. Otho A. 6, was traced in detail. For one complete century after the fire which, on the 23d of October, 1731, proved so disastrous to the Cottonian Library, this MS., reduced to charred and unpromising fragments, lay deposited in a wooden case, while the catalogues of the library, and the editions of the work reported it as "lost." Previous to the year 1839, the Rev. Joseph Stevenson served as an assistant in the British Museum. As nearly as he was able, in a recent interview with the writer, to recall the incident, it was in the year 1834 or 1835 that Sir Henry Ellis, then the principal Librarian, caused to be brought from the garret of the house, then occupied by the library, some of the old débris of the fire of 1731. Among this rubbish were the remains of this Boethian MS., which were put into the hands of Mr. Stevenson and of Mr. John Holmes, also an assistant, for examination. They found the MS. in a most sad condition; the fire had left no trace of the original binding and sewing, and the burnt and fragmentary leaves, thus entirely detached, had become hopelessly confused. Mr. Stevenson, being familiar with Anglo-Saxon, took hold of the black fragments, while Mr. Holmes stood by with a copy of the Latin original; and so they, together, after many days of patient labor, worked out the proper order of the pages, a task attended by extreme difficulties. The MS., thus arranged, was next put, but evidently after the lapse of some years, into the hands of the "restorer" (Mr. Gough), and was finally bound in the year 1844, as is indicated by the note, dated July, 1844, on the fly-leaf of the bound volume. Grein, however, fourteen years later, still writes: "Das einzige Originalmanuscript dieser metra . . . . ist ein Raub der Flammen geworden."

Of this MS., so far as it concerns the text under consideration, several leaves at the beginning and three in the body of the work, are now wanting entirely; there are left 129 leaves, in varying degrees of completeness. The last third of the MS. is little injured, and very legible, The first two-thirds are, however, quite different. Here the leaves are reduced to fragments, which contain from one-tenth upwards to almost the whole of the original page. An estimate of what they supply must, however, be placed as high as three-fourths of the original matter. While a goodly number of these fragments are as bright and legible as a fresh print, most of them are so charred and black, so thoroughly cooked and roasted, as to appear, at first sight, quite hopeless. Yet it is found that, in many of the blackest pages, the ink has been baked in with the permanence and lustre of a porcelain polish, and that, by catching the written line under the right conditions of light, every trace may be read. In other places the ink seems to have boiled, and, breaking its appointed bounds, to have stolen into the adjacent fibre of the parchment, leaving upon the surface a blurred impression, difficult to read.

This work has suffered at the hands of its editors, by reason of two fundamental errors committed by them: The prose text has been wrongly based upon the Bodleian MS.; and the Junian transcript, as printed by Rawlinson, has, in all cases, been used in place of the MS. itself.

Something like a century of time separates the two MSS. The late and "corrupt" language of the Bodleian is further injured by the ignorance of an untrustworthy scribe. A text, based upon the earlier Cott. MS., would greatly promote the study of the text.

In the texts of both MSS. there appears a non-West-Saxon dialect in mechanical combination with the original forms. This secondary dialect betrays the hand of the copyists, and belongs to a region bordering upon Kent. In this region the meters were perhaps *made* and substituted in the line of MSS. to which the Cott. belongs, while, in another branch of transmission, the prose version remained intact.

Junius was not a mechanical copyist. In his transcripts he always allowed himself great freedom in normalizing and emending a text. He was also capable of misreadings and of misinterpretations. The too exclusive use of his transcript by the editors of the Boethius has kept them too far removed from the MS., and has led to the introduction into the Grammars and Dictionaries of the language of many forms which have no such existence.

The conflicting theories regarding the authorship of the meters were briefly reviewed, and summarily dismissed as insufficient. The question must be approached from the side of a minute study of the dialect of the entire work. If, as can no longer be doubted, the versifier operated mechanically with the prose version, having no regard to the Latin original, then the dialect of the text so employed, as well as that of the versifier himself, must be determined. If it can be shown that the prose text had already, previous to the versification, taken up dialectic forms; or, on the other hand, if the versifier belonged to this out-lying dialect, the King becomes at once relieved of all responsibility for the meters.

On the Financial History of Athens. By C. D. Morris.

[Abstract of a paper read at a meeting of the University Philological Association, November 7, 1884].

In this paper an account was given of some recent essays of J. Beloch on the following points: (1) the amount of the tribute paid by the Athenian subject-allies; (2) the temple-treasuries as substitutes for a formal state-treasury at Athens; (3) the amount of the temple-revenues; (4) the pay of the jurors in the Athenian law-courts; (5) the cost of the Peloponnesian war to Athens; (6) the functions of the officers called Poristae. These were seen to be of a very speculative character, being based to a great extent on questionable inferences drawn from fragmentary inscriptions. In regard to the first, for instance, the special purpose of which was to reconcile the statement of Thucydides with that of Diodorus as to the amount of tribute paid by the Athenian allies, it was shown, (1) that the sources of revenue which Beloch supposes Thucydides to have erroneously included in his estimate are in all probability referred to in certain other words which Beloch neglects to quote, and if so, are not really available for the purpose for which he adduces them; (2) that negative inferences drawn from non-occurrence of names or figures in the inscriptions as we have them are to be made with great caution; since in one instance, at least, in this paper we have positive proof that the conclusion drawn is erroneous.

Latin *usque* = Vedic *ácchā̆*. By M. Bloomfield.

[Abstract of a paper read at a meeting of the University Philological Association, November 7, 1884.]

Modern etymologists agree in regarding *usque* as derived from the relative stem *quo-* and the enclitic *que.* So Bopp^3 II, 208 and Corssen, KZ. III, 292. The latter explains *us-* as a contraction from *ubi-s, i. e., ubi* and *s* the reduced comparative suffix *ius;* others have since then regarded the *s* as a 'locative' suffix added to *ubi.* It is believed that the word has nothing to do with the relative stem, but that it is identical with Vedic *ácchā̆* 'up to, towards.' The only etymology for this word worth reporting is that given by Benfey in the fourth part of his 'Quantitätsverschiedenheiten in den Saṅhita- und Pada- texten,' p. 4; he regards the word as a Prākrit form of **aksā,* a Vedic instrumental of *aksa* 'eye': 'before the eyes.'

Phonetically *usque* and *acchā̆* correspond almost perfectly. The ground-form is *osque* (*qu* being the velar guttural). Latin *u* = Sanskrit *a* and I. E. *o* we have in *umerus* = *aṅsa; ferunt* = *bharanti; equus* = *açvas. Acchā̆* is employed in two very distinct functions: (1) with verbs of speaking; (2) with verbs of motion. In the latter value it coincides quite extensively with the prominent functions of *usque, e. g.,* in the two sentences:

Tvám . . . nadyà indra sártave *ácchā̆* samudrám asṛjah. . . . (RV. I, 130, 5.)

'Thou, O Indra didst let loose the rivers to flow to the ocean.'

In ultimam provinciam se conjecit Tarsum *usque.* Cicero.

Especially noteworthy is the parallelism between the combinations: *usque in, usque ad,* and *ácchā̆ ábhi, acchā̆ ā, acchā̆ ud.* Cf. the following pairs of sentences:

iva . . . ácchā indrasya . . . ábhi vītím arsa (RV. IX, 97, 25.)
to the feast of Indra like a race-horse.'
e legatos ad eum *usque in* Pamphyliam. (Cicero.)
o from the Atharva Veda:
açā́m . . . *acchā ā́* yanti (brāhmaṇā́ḥ); AV. XII, 4, 14.
rahmans come to that wonderful cow.'
stómo mārutaṁ çardho *ácchā* rudrásya sūnū́nr yuvanyū́nr *úd* açyāḥ
V, 42, 15.)
y this song of praise reach up to host of the Maruts, to the youthful
f Indra.'
pare with this: ab imis unguibus *usque ad* verticem summum. (Cicero.)
lation of *usquam* to *usque* is probably that of one case-form of an adverb
ther. Cf. Vedic *evā: evam; sadā: sadam*; *kathā: katham; itthā:*
; Sanskrit *purā:* Greek πάρος, etc.

πων 'ripe,' and πέπων 'mild, weak.' By M. Bloom-
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[ract of a paper read at the meeting of the University Philological Association,
ber 7, 1884.]

lexicons treat πέπων in all its meanings as one and the same word,
ng all values from the primary one of 'ripe.' So Liddell and Scott:
pe' opposed to ὠμός 'raw.' II: 'soft, mild, gentle' as *e. g.*, in πέπον
νηιάδη (Il .5, 109); ὦ πέπον (Il. 6, 55); κριὲ πέπον (Od. 9, 447);
in a bad sense: 'soft, weak:' ὦ πέπον, ὦ Μενέλαε (Il. 6, 55); ὦ
ες 'ye weaklings.' Two objections must be made to this development
anings. First, the word in its supposed primary meaning of 'ripe'
ot occur in Homer and Hesiod at all, but appears first in Herodotus
t sense; secondly, the development of the meanings under II, from
' is not very natural, as we can readily realize from the metaphorical
f English 'ripe' and German 'reif.'
ων in the sense of 'ripe' has been identified with Sanskrit *pakva* 'ripe.'
the meanings under II, must be separated from that under I, was
suggested to me by an old formula in the Tāittirīya-saṅhitā III,
4: ahc dāidhiṣavya ud atas tisthā 'nyasya sadane sīda yo 'smat
rah: 'O Dāidhisavya rise from here, seat yourself upon the seat of
er who is *younger* (or *weaker*) than we are.' This word *pāka* I identify
πέπων in its second set of meanings.
ka occurs as an adjective in the sense of 'young;' next 'young of an
l,' 'child' *e. g.*, dhenuh *pākavatsā* 'a cow with a young calf;' then
le' both in the sense of 'upright' and in the sense of 'foolish':
tā́ 'si *pā́kasyā́* 'tho hantā́ 'si raksásaḥ, (AV. N. 19, 3.)
u art the protector of the innocent,the slayer of the demon.'
te *pā́kaḥ* Kṛṇavad ápracetaḥ (RV. X, 7, 6.)
t good can the fool without intelligence do to you.'
us the earlier meanings of πέπων: 'soft, mild, weak,' belong to this
and there is no reason why the phrase κριὲ πέπον should not be trans-
'my little ram,' or why the use of the word in the phrase ὦ πέπονες
directly equivalent to the use of *pākatara* in the formula from the
rīya-saṅhitā.
far as the form of the Greek words are concerned both πέπων = *pakva*,
έπων = *pāka* have been transferred to the weak declension (n–declen-
cf. upon this subject Osthoff Forschungen, II, pp. 13–29.

n the Etymology of Elixir. By Cyrus Adler.

tract of a paper read at the meeting of the University Philological Association,
ber 5, 1884.]

e usual etymology of the word *elixir* is that it is composed of the Arabic
e *el* and *iksir*, an Arabic word meaning "philosopher's stone." This etymology was very wide-spread [cf. Phillip's "New World of Words or Universal English Dictionary," (6th Ed., London, 1706); Johnson's Dictionary; Skeat's Etymological Dictionary, (1882); the article on Alchemy in the Encyclopædia Britannica, (9th Ed.); Wiegand's Deutsches Wörterbuch, (according to him elixir came into German in the 17th century out of late middle Latin); Brachet's Dictionnaire Etymologique de la Langue Française; Petri's Handbuch der Fremdwörter in der deutschen Schrift-und umgangssprache, (13th Ed., by Emanuel Samostz, Leipzig, 1880); Schiller's Dictionnaire d' Etymologie Française; Tommaseo's Dizionario della Lingua Italiana, Turin, 1865; and the 1874 edition of the Dictionary of the French Academy.]

To this etymology Hammer-Purgstall gave his unqualified assent. There was some disposition, however, to look to another language. Thus the Webster of 1828 treats it along with elixation from Latin *elixo*, while in the Dictionaire Provençal Français (Digne, 1847,) it is derived from Greek *ἄλκω or ἀλέξω. Presently *'iksîr* began to be examined from the Arabic point of view. It is placed by the Arabic lexicographers as a derivative of the stem *kasara* to break. Dozy (Supplement aux dictionnaires Arabẹs) declared that *'iksîr* was unoriginal in Arabic and was a formation from Greek ξηρόν, ξήριον, "a dry drug." Fleischer (Z. D. M. G., Vol. XXX, p. 536,) referred it to a Coptic word *scala*. Many lexicographers adopted the derivation of the Arabic word from the Greek on the authority of Dozy, still regarding *el* as the article. This notion is not original with Dozy. We find it in Bochart (London, 1661,) and quoted by Skinner in his Etymologicon Linguae Anglicanae (London, 1671). We find it adopted on the authority of Dozy by Wedgewood (London, 1872), by the Imperial Dictionary (London, 1882); by Skeat in the supplement to his Etymological Dictionary, just published; by Devic (Dictionnaire Etymologique des mots Français d'origine orientale); by Diez, who remarks, "*Aus Latein elixus welches andere aufstellen, würde sich die endung ir nicht erklären* (Etymologisches Wörterbuch der Romanischen Sprachen). Most enthusiastic is F. Gildemeister (article on Alchemy, Z. D. M. G., Vol. XXX), who declares "*das* iksir *das griechisch* ξήριον *sei, ist unzweifelhaft.* According to this derivation the *elif* must be prosthetic and the word a formation of the fourth conjugation. Such a noun must, however, have the form *iksar*, and the simple fact has been overlooked that the form *'if'îl* has no existence in Arabic. Then again, in regard to *el*, which all have agreed is the Arabic article. That an Arab would take the sound *el* for the article there can be no doubt, but Arabic words which have come into European languages with the article always possess it in the form *al*. Thus Devic's work (cited above) contains forty-seven words in which the article appears as *al*, elixir being the only exception. The same is true of English. The New Dictionary of the English Philological Society contains forty words with *al*, and in our ordinary dictionaries elixir is again the sole exception. If then *iksir* cannot be an Arabic form, even as manufactured from a foreign word, and if it is very improbable that *el* is the Arabic article, we cannot help concluding that the foreign word from which *'iksîr* was taken must have possessed it in that form, in other words the Arabs must have taken the word *elixir* as it stood, and regarded *el* as the article (just as they made Iskander out of Alexander), and *iksir* as the word proper. On no other supposition is the form explainable. The word seems to have two distinct sets of meanings existing side by side, and perhaps an accurate determination of the period at which the different meanings came in would assist in its etymology. Chaucer used it as the philosopher's stone (Canterbury Tales, l. 17, 262); Milton uses it in the sense of essence (Paradise Lost, III, 607); Ben Jonson in his play, The Alchemist, makes it a medicine (Act II, Scene I, Act III, Scene II). From this meaning, too, no doubt, comes the French slang *Elixir de Huzzard*, poor brandy. Where the form elixir is to be derived from, is a difficult matter. Latin *elixus* would furnish the meaning well enough, but as Diez says, from this form the ending *ir* cannot come. Many Latin verbs make their infinitive in Portuguese in *ir*, but none of the first conjugation.

RECENT PUBLICATIONS.

Land Laws of Mining Districts. By Charles Howard Shinn. Johns Hopkins University Studies in Historical and Political Science. Second Series, No. 12. pp. 69. December, 1884.

Some part of the material here presented will re-appear in a volume entitled "Mining Camps, a Study in American Frontier Government," which will be published early in 1885 by Charles Scribner's Sons, New York. Portions of this work were read last year before the "Historical and Political Science Association" of the Johns Hopkins University. An article upon "California Mining Camps," in the "*Overland Monthly*" for August, 1884, one upon "The Golden Prime of Forty-Nine" (illustrated), which appeared in the "*Magazine of American History*" for November, and one upon "Enactments of the Early Miners," in the *Overland* for December, comprise the author's publications in this field.

Mr. Shinn's investigation, of which the above essay is a portion, is primarily a study of mining commonwealths, and of their original contributions to American institutional history. It includes a study of the Spanish land system and mining laws in Mexico and California, and of the inter-relations of priest, alcalde and commandante in mission, pueblo and presidio; for otherwise the place of the true mining camp, as a nucleus of most effective organization, cannot be fully understood. It is, to state the matter broadly, an attempt to break ground in a comparatively new field, and to examine the laws and customs, not of primitive pastoral, nor of primitive agricultural communities, but of the workers in ores and auriferous river-sands.

The material accumulated for these studies has been arranged in twenty-six divisions, to each of which a separate chapter has been assigned. The first of these is devoted to an examination of the various mining systems of the ancients, so far as showing traces of local organization; the second, to an investigation of the mining codes of the twelfth and thirteenth centuries, and the pregnant idea of "mining-freedom" (*Bergbaufreiheit*), first clearly enunciated by the Germanic races, and of vital consequence since the time of Otto the Great; the third, to a study of the ancient mining customs of Cornwall, the Stannary Courts, Bar-motes, and Tin-bounds, the survival of Celtic influences and the similarity to modern laws and customs of "mining camps." These three parts lead naturally to a study of "early mining in the United States," particularly in the Mississippi Valley. This chapter serves as a link connecting camp mining laws with chapters devoted to the Spanish Influence, for the American miners who attempted local organization in Iowa and Missouri struggled with and conquered the institutions of Spain that, a generation later, were met in far stronger shapes on the shores of the Pacific. The four following divisions are occupied with the "Spanish American System of Government;" the "Mining System of Mexico;" the "Missions" of California; Spanish Town Government, the Pueblo; and a study of "Alcalde" Rule. But the chief problem is: What element in the development of the Western third of the United States was a contribution of the Mining-Camps? The sixteen subsequent divisions are therefore devoted to a study, from original sources, of the early Camps of California, Nevada, Montana, Colorado, and the entire Sierra and Rocky Mountain Region; of their laws, customs, government, civil and criminal codes, land-laws, legislative enactments, peculiar officers, such as arbitrators, standing committees and alcaldes, the last an officer borrowed from the Spanish, and the arbitrators similar in powers and duties to the "Conciliacion" men of Mexico. The basis of all camp-law is shown to be the assemblage of the freemen, the "folkmote of the Sierra." The miners elected and at times deposed their own officers. They ruled their camps with a firm hand, securing law and order to a remarkable degree, according to the witness of numerous English and American travellers, and the statements of pioneers still living. They even organized town-governments, maintained hospitals, and built roads. For years after a State government had been organized in California the "mining districts" were units of local life. The closing divisions of the subject are devoted to a consideration of the "Permanent influence of the typical mining camps upon the present laws and social life of the Far West." This influence, it is held, has been so great that no history of the region west of the Mississippi can properly be written without taking it into account. It has created a system of mining jurisprudence, and it has contributed social and intellectual elements of no small importance to American history.

Maryland's Influence upon Land Cessions to the United States. With minor papers on George Washington's Interest in Western Lands, the Potomac Company, and a National University. By Herbert B. Adams. Johns Hopkins University Studies in Historical and Political Science. Third Series, No. 1. pp. 102. January, 1885.

These papers were first printed by the Maryland Historical Society in 1877, (Fund Publication, No. 11), under the title "Maryland's Influence in Founding a National Commonwealth." They are now published in a somewhat revised form, for the sake of advancing the lines of institutional study at the Johns Hopkins University, and at the same time promoting the cause of American Economic History.

The author calls attention to the territorial foundations of the American Union and points out the fact that our Public Lands stand in the same fundamental relation to our National Commonwealth as did Common Lands to the Village Republics of New England. The Great West was the *Folkland* of the United States; it bound them together by economic interests when they would otherwise have fallen apart after the Revolution. To trace out the further constitutional influence of our Public Lands upon the development of these States, which have increased and multiplied within the national domain as did New England Parishes within the original limits of one Town,—this line of investigation is now suggested for further contributions to American Institutional History.

The planting of English Institutions in each of those Western States and Territories is a story not yet told. The agrarian and general economic history has hardly been touched. For the coming student there are questions of the deepest interest respecting the disposition already made of Public Lands, both State and National. George W. Knight, Ph. D., of the University of Michigan, prepared for his Doctor's thesis a valuable monograph upon "Federal Land Grants to Education in the North-west Territory," an abstract of which was presented at the first meeting of the American Historical Association, by Professor Charles Kendall Adams, and which is to be printed in full in the the Proceedings of the Association, Volume I, Number 3. A similar research upon "Land Grants to Settlers in the Western States," has been undertaken by Shosuki Sato, who is specially commissioned for that work by the Japanese Government, and who is now prosecuting his agrarian studies at the Johns Hopkins University. Land Grants to Railroads should also be investigated as a chapter in the History of American Politics as well as of American Economics. But the influence of Railroads upon immigration and transportation, upon state and municipal life, opens into still more attractive fields. There seems to be no limit to the economic and institutional interests connected with the disposal of our Western Territory.

But there are vast questions lying back of the disposal and settlement of our Public Lands; there are yet to be studied in minute detail the records of national and colonial acquisition of territory; the conflicting claims of states and nations; crown lands; royal provinces; chartered colonies; Indian lands; Indian, English, Dutch, and French land-tenure; agrarian survivals, etc. There are sub-strata of economic history and historical geography in each one of these United States. To some of the very oldest forms of fossil land-tenure renewed attention will be called in the Studies by a paper on "The Land System of the New England Colonies," by Melville Egleston. The Land System of Virginia, and the Dutch Village Communities upon the Hudson River are also to be treated in future numbers of the Studies. Canadian Feudalism will be investigated; and other topics of an agrarian and institutional character will doubtless suggest themselves to other students.

The second series of Studies in Historical and Political Science, comprising 630 pages in all is now completed. **Subscribers have been furnished with an index and with a general title page, including the special sub-heading "Institutions and Economics." A few copies of this volume bound in cloth, are offered for sale at $3.50.**

AMERICAN JOURNAL OF PHILOLOGY. Edited by Professor Gildersleeve. Vol. V.

The fourth number of the fifth volume is now in press and will be issued shortly to subscribers. It will contain a continuation of Professor SHORT'S work on the *Revised Version of St. Matthew;* THOMAS DAVIDSON, on *Child's Ballads;* W. H. SIMCOX, a collation of a *MS. of St. Luke;* J. W. BRIGHT, *Anglo-Saxon Glosses to Boethius;* short articles by Professors MORRIS, TOY and others, besides *Reviews* and *Reports.*

Vol. V, 1, (Whole No. 17).

Article I.—On the Elegies of Maximianus. By ROBINSON ELLIS.

"Among the Latin poems which have come down to us from the sixth century of the Christian era, the love elegies of Maximianus, 686 lines in all, deserve prominent mention whether for the general excellence of the metre or for the peculiar experience of the author as a lover." Professor Ellis gives a sketch of Maximianus and his adventures, based of course on the poems themselves, discusses the editions, and the MSS. and gives two specimens of Maximianus' diction and metre, with comments.

Article II.—On Certain Irregular Vedic Subjunctives or Imperatives. By MAURICE BLOOMFIELD.

Of this elaborate paper a full abstract will be found in *University Circular,* No. 27, (Vol. iii, p. 6).

Article III.—Researches in the Cyrenaica, with some account of its History since the decline of the Empire. By FARLEY BROWN GODDARD.

After a description of the Cyrenaica and an account of the imperfect explorations made thus far, Mr. Goddard emphasizes the importance of the work yet to be done in the following words: "There are very few fields where the science of archæology can expect so much light for its dark places as from this newly discovered land, where are strewn from one end to the other the ruins of ancient towns, and where the enormous task some time to be performed, will glorify forever those who, with determination and with adequate resources, undertake it."

Article IV.—The Nahuatl-Spanish Dialect of Nicaragua. By A. M. ELLIOTT.

See *University Circular,* No. 30, (Vol. iii, p. 74).

Article V.—The Babylonian "Woman's Language." By PAUL HAUPT.

See *University Circular,* No. 29, (Vol. iii, p. 57).

In the *Notes* A. C. MERRIAM comments on an inscription of Dodona, and THOMAS CHASE defends the introduction of Aegeus in the Medea of Euripides.

Reviews are given of *Kuhn's Ueber Herkunft u. Sprache der transgangetischen Völker* by W. D. WHITNEY; *Wordsworth's Old Latin Biblical Texts,—Scrivener's Introduction to the Criticism of the New Testament* and *Bonnet's Acta Thomae* by J. RENDEL HARRIS; *Brinton's Library of Aboriginal American Literature* by C. H. TOY; *Körting's Encyclopaedie und Methodologie der Romanischen Philologie, Horning's Zür Geschichte des Lateinischen* c. vor e. u. i. *im Romanischen,* and *Levy's der Troubadour Bertolome Zorzi* by A. M. ELLIOTT; *Hunt's Caedmon's Exodus and Daniel* by H. WOOD.

Reports are given of *Rheinisches Museum;—Neue Jahrbücher für Philologie u. Paedagogik;—Revue de Philologie;—Englische Studien;—Germania.*

Vol. V, 2, (Whole No. 18).

Article I.—On the Elegies of Maximianus, II. By ROBINSON ELLIS.

Emendation and discussion of some fifty passages in Maximianus.

Article II.—Analogy and Uniformity. By M. W. EASTON.

The positions taken in this article are reviewed by Dr. Bloomfield in the paper following.

Article III.—On the Probability of the Existence of Phonetic Law. By MAURICE BLOOMFIELD.

Abstracts of both articles are given in *University Circular,* No. 30, (Vol. iii, pp. 73, 74).

Article IV.—Verbal Parasynthetics in -a in the Romance Languages. By A. M. ELLIOTT.

An abstract is given in *University Circular,* No. 29, (Vol. iii, p. 55).

Article V.—Historical Sketch of Syriac Literature and Culture. By A. L. FROTHINGHAM, JR.

Syriac Literature and Culture are presented under the following heads: I. Formative and Original Period, II-VII Centuries; II. Artificial and Scientific Period., VII-XIII Centuries.

Article VI.—On Direct Speech Introduced by a Conjunction. By EDWARD H. SPIEKER.

An abstract is given in *University Circular,* No. 20, (Vol. ii, p. 26).

Notes by H. E. SHEPHERD on *rathe,* separation of the rhematic *to,* and the origin of the mathematical *x.*

Reviews are given of *Archiv für Lateinische Lexikographie und Grammatik* by M. WARREN; *Humphrey's Observations sur Thucydide,* I. xi., and *Two Papers by Karl Brugmann* by C. D. MORRIS; *Kluge's Etymologisches Wörterbuch der deutschen Sprache* by W. T. HEWITT; *Foerster and Koschwitz's Altfranzösisches Uebungsbuch zum Gebrauch bei Vorlesungen und Seminarübungen* and *Schuchardt's Kreolische Studien* by A. M. ELLIOTT; *Delbrück's Indogermanische Grammatiken* by E. CHANNING; *Hopken's De Theatro Attico saeculi ante Chistum quinti* and *Ueber das Griechische und Römische Theater,* by F. G. ALLINSON; *Nöhl's Ciceronis Orationes Selectae,* and *Kukula's De Tribus Pseudacronianorum Scholiorum Recensionibus,* and *Stangl's der sogenannte Gronov Scholiast zu elf Ciceronischen Reden* by M. WARREN; *Neudrucke deutscher Literaturwerke des* XVI *und* XVII *Jahrhunderts.*

Reports are given of *Mnemosyne;—Hermes;—Athena Parthenos der Ermitage.*

Vol. V, 3, (Whole No. 19).

Article I.—The Study of Hindu Grammar and the Study of Sanskrit. By WILLIAM DWIGHT WHITNEY.

The object of this article is "to impress on the minds of scholars that the study of the Sanskrit language is one thing and the study of the Hindu science of grammar another and a very different thing; that while there has been a time when the latter was the way to the former, that time is now long past, and the relation of the two reversed; that the present task of the students of the grammar is to make their science accessible, account if possible for its anomalies, and determine how much and what can be extracted from it to fill out that knowledge of the language which we derive from the literature; and that the peculiar Hindu ways of grouping and viewing and naming facts familiar to us from the other related languages are an obstacle in the way of a real and fruitful comprehension of those facts as they show themselves in Sanskrit, and should be avoided."

Article II.—The Jurisdiction of the Athenians over their allies. By C. D. MORRIS.

An abstract is given in *University Circular,* No. 29, (Vol. iii, p. 55).

Article III.—Vowel-lengths in King Alfred's Orosius. By ALBERT S. COOK.

A list of long vowels contained in King Alfred's Orosius, Part I.

Article IV.—Lucan as historical source for Appian. By B. PERRIN.

Proof that Appianus, Bell. Civ. II, 75, is taken from Lucan, Phars. VII, 326, 333.

Article V.—The meaning of Baalim and Ashtaroth in the Old Testament. By A. L. FROTHINGHAM, JR.

The author of this paper sets aside the opinion that the plural forms of Baalim and Ashtaroth represent only images of these divinities, as in discord with the texts of the Old Testament and all extra biblical evidence.

The other two hypotheses are:

I. Baalim and Ashtaroth were used as common nouns to signify *gods* and *goddesses* and to the Yahvistic worshipper, the strange and false divinities of the surrounding Hamitic nations.

II. They may represent the many various aspects of Baal and Ashtaroth, whether proceeding from the individualization of certain of their attributes or from the different centres of their worship.

The arguments on both sides are stated and a reconciliation is attempted.

Article VI.—Friedrich Ritschl. By B. L. GILDERSLEEVE.

In this article Professor Gildersleeve has reproduced the substance of his address before the Johns Hopkins Philological Association in October, 1883. The sketch dwells on the earlier periods of Ritschl's life and work. The material is taken from Ribbeck's Life; for the form and the personal reflections the author is of course responsible. Throughout, Ritschl is held up as the model of the moulding and inspiring teacher.

In the *Notes* Professor LAMBERTON proposes a new reading in Plato, Gorgias, p. 497 A.

This number contains *Reviews of Bosworth's Anglo-Saxon Dictionary,* (ed. by T. Northcote Toller), and the *Philological Society's New English Dictionary,* by J. M. GARNETT; *Foerster's Alt-Französische Bibliothek* and *Körting's Encyklopaedie und Methodologie der Romanischen Philologie,* by A. M. ELLIOTT; *Goebel's Über tragische Schuld und Sühne,* by H. WOOD.

The reports give abstracts of *Anglia;—Mnemosyne;—Hermes;—Archiv für Lateinische Lexicographie und Grammatik,* and *Journal Asiatique.*

LIST OF MODELS OF MATHEMATICAL SURFACES BELONGING TO THE JOHNS HOPKINS UNIVERSITY.

The following is a list of models for the purposes of geometrical instruction purchased by the University within the last two years.

The usefulness of such models is evident, especially in the study of the higher surfaces, of which an accurate conception, without such aid, is almost impossible. But even in the more elementary work, considerable time is saved by giving the student, at the outset, an accurate idea of the forms of the surfaces to be studied. It may be claimed that, by the use of models, one of the chief advantages of geometrical study, namely the education of the imagination, is lost; but the concepts of such imagination ought certainly to be based upon accurate foundations, and probably the principal advantage of the use of these models consists in giving the student a good idea of the "simple" singularities, which can hardly be done by any purely analytical description. All the so-called "simple" point-singularities of surfaces are adequately illustrated by this collection. After these are fixed in the mind the imagination can exercise its proper function, which is constructive not creative. There are very few surfaces of higher orders of whose complete forms any adequate idea can be obtained from the analytical representatives, and still more impossible is it to acquire, in this way, even a general idea of all the different varieties of surfaces of a given order. Finally the mental image obtained from a visible object is much more lasting and definite than that obtained from any description.

This collection contains models of all species of quadric surfaces, of most genera of cubics, of a considerable number of genera of the more singular quartics, and of many algebraic surfaces of higher orders and transcendental surfaces, among which may be mentioned surfaces of constant measure of curvature and of constant mean curvature. Several cases of the development of one surface upon another are illustrated, notably by means of flexible brass models. The circular sections, rectilinear generators, lines of curvature and geodetics of quadrics are shown, as well as lines of curvature, asymptotic curves and geodetics on surfaces of higher orders.

The wooden models of simple solids and surfaces of the second order, as well as the descriptive geometry models, were made by by J. Schröder of Darmstadt (whose agents in this country are James W. Queen & Co. of Philadelphia), and the card and thread models of surfaces of the second order and the plaster models of surfaces of the second and higher orders were published by L. Brill in Darmstadt.

W. E. Story.

I. SIMPLE SOLIDS.

Wood Models.

1. *Right regular triangular prism.*
2. *Oblique triangular prism*, with regular bases.
3. *Right regular triangular prism*, divided into three equivalent triangular pyramids.
4. *Square prism.*
5. *Square prism*, divided into two triangular prisms by a plane through the axis.
6. *Right regular hexagonal prism.*
7. *Oblique hexagonal prism*, with regular bases.
8. *Right regular pentagonal prism.*
9. *Oblique pentagonal prism*, with regular bases.
10. *Right circular cylinder.*
11. *Right cylinder*, with semi-circular bases.
12. *Oblique cylinder*, with circular bases.
13. *Right circular cylinder*, cut by a plane inclined to the axis at an angle of 45°.
14. *Right rectangular prism*, divided into two triangular prisms by a plane through the axis.
15. *Cube.*
16. *Oblique rectangular prism*, on a square base; axis inclined to base at an angle of 60°.
17. " " " " " " " " " " " 45°.
18. *Right square prism*, cut by a plane inclined to the axis at an angle of 45°.
19. *Regular tetrahedron.*
20. *Square prism*, divided into two triangular prisms by a plane through opposite edges of the bases.
21. *Right regular triangular pyramid.*
22. *Oblique triangular pyramid*, with regular base.
23. *Square pyramid.*
24. *Oblique quadrangular pyramid*, with square base.
25. *Square pyramid*, truncated.
26. *Right regular hexagonal pyramid.*
27. *Oblique hexagonal pyramid*, with regular base.
28. *Right regular pentagonal pyramid.*
29. *Oblique pentagonal pyramid*, with regular base.
30. *Right circular cone.*
31. *Oblique cone*, with circular base.
32. *Right circular cone*, with elliptic, parabolic and hyperbolic sections.
33. " " " cut by a plane through the axis.
34. " " " truncated.
35. *Sphere.*
36. " divisible into hemispheres, sectors and segments.
37 *Regular icosahedron.*
38. *Regular dodecahedron.*
39. *Regular octahedron.*
40. *Hollow hemisphere.*
41. *Double cone.*

II. SURFACES.

QUADRIC SURFACES.

Wood Models.

1. *Prolate spheroid.*
2. *Oblate spheroid.*
3. *Oblate spheroid.*
4. *Ellipsoid.*
5. *Hyperboloid* of rotation.
6. *Paraboloid* of rotation.
7. *Elliptic hyperboloid.*
8. *Elliptic paraboloid.*
9. *Hyperbolic paraboloid.*
10. *Conoid.*

Card Models.

Formed of circular sections of both systems (excepting No. 7, which is formed of rectilinear generators of both systems).

11. *Elliptic cone.*
12. *Ellipsoid.*
13. "
14. *Hyperboloid of two sheets* (model shows one sheet).
15. " " *one sheet.*
16. *Elliptic paraboloid.*
17. *Hyperbolic* "

Plaster Models.

18. *Right circular cone*, showing elliptic, hyperbolic, and parabolic sections (diameter of base 18.5 cm., altitude 29.5 cm.).
19. *Sphere* (radius 4.5 cm.).
20. *Ellipsoid*, showing principal sections (axes $\sqrt{3} : \sqrt{2} : 1$, Major semiaxis 5 cm.).
21. " " lines of curvature (axes as in No. 20).
22. " " principal sections (axes $\sqrt{3} : \sqrt{2} : 1$, Major semiaxis 9 cm.).
23. " " lines of curvature (axes as in No. 22).
24. " " geodetics through two umbilics (axes $\sqrt{3} : \sqrt{2} : 1$, Major semiaxis, 9.4 cm.).
25. " *of rotation* (prolate spheroid), showing geodetics (axes 3 : 2 : 2, semiaxis of rotation 8.75 cm.).
26. " " (prolate spheroid), showing two varieties of envelope of geodetics through a common point (axes 3 : 2 : 2, semiaxis of rotation 6 cm.).
27. " " (oblate spheroid), showing two varieties of envelope of geodetics through a common point (axes 3 : 3 : 2, semiaxis of rotation 3.5 cm.).
28. *Hyperboloid of two sheets*, showing principal sections (transverse semiaxis 2 cm., see No. 40).
29. " *of two sheets*, showing lines of curvature (axes as in No. 28).
30. " *of one sheet with asymptotic cone*, showing principal sections (semiaxes of gorge ellipse 4 cm. and 2.1 cm., height of model 23 cm., see No. 40).
31. " *of one sheet with asymptotic cone*, showing both systems of rectilinear generators (axes as in No. 30).
32. " *of one sheet with asymptotic cone*, showing lines of curvature (axes as in No. 30).
33. *Elliptic Paraboloid* bounded by section perpendicular to axis, showing principal sections (semiaxes of base ellipse 9.5 cm. and 6 cm., height of model 20 cm.).
34. " " showing elliptic sections perpendicular to axis (dimensions as in No. 33).
35. " " showing lines of curvature (dimensions as in No. 33).
36. *Hyperbolic paraboloid* (equilateral) bounded by circular cylinder about the axis showing principal sections (diameter of cylinder 14 cm.).
37. " " showing both systems of rectilinear generators (dimensions as in No. 36).
38. " " showing hyperbolic sections perpendicular to axis (dimensions as in No. 36).
39. " " showing lines of curvature (dimensions as in No. 36).
40. *Elliptic cone*, showing principal sections (semiaxes of base 10.4 cm. and 5.4 cm., altitude of cone 11.5 cm.). This is the asymptotic cone to Nos. 28-32.
41. " " " lines of curvature (dimensions as in No. 40).
42. *Elliptic cylinder*, showing twisted cubical ellipse (semiaxes of base 4 cm. and 2.3 cm., altitude 10.5 cm.).
43. *Hyperbolic cylinder*, both sheets, showing twisted cubical hyperbola (altitude 10 cm.).
44. *Parabolic cylinder*, showing twisted cubical hyperbolic parabola (altitude 10.3 cm.).
45. " " showing twisted cubical parabola (altitude 10.3 cm.).

Thread Models.

46. *Hyperboloid of one sheet with asymptotic cone*, showing both systems of rectilinear generators, threads stretched between two parallel elliptic sections (axes of gorge ellipse 4.2 cm. and 2.6 cm., height of model 24 cm.).

47. *Hyperbolic paraboloid*, showing both systems of rectilinear generators, threads stretched between two parallel parabolic sections (dimensions 28 cm., 17 cm., 20.2 cm.).
48. “ “ showing both systems of rectilinear generators, threads stretched between opposite sides of a gauche rhombus jointed at two opposite vertices (side of rhombus 32 cm.).
49. *Circular cylinder with tangent plane*, both bases can be inclined to make elliptic cylinder, and upper base can be rotated to make hyperboloid of one sheet touched by a hyperbolic paraboloid along a common generator; shows also a ruled quartic surface with line of striction (radius of cylinder 20 cm., altitude 26 cm.).
50. *Two circular cones*, showing portion of one sheet of outer cone and both sheets of inner cone, with tangent plane to outer cone; both bases can be inclined and the upper base rotated as in No. 49, in limiting position shows both systems of generators of the same hyperboloid touched by hyperbolic paraboloid (radius of upper base 10 cm., radius of lower base 20 cm., altitude of cones 22.5 cm.).

CUBIC SURFACES.

Plaster Models, excepting No. 78.

C_2 denotes a conical point or nicnode, B^k a binode reducing the class by k, U_k a unode reducing the class by k (Salmon's Geometry of Three Dimensions, §§ 522, 523). In Nos. 52–57 the surface consists of a tetrahedral even sheet of positive curvature and an odd sheet of negative curvature.

51. *Non-singular cubic* (diagonal surface) with 27 distinct real straight lines.
52. *Cubic with* $4C_2$; the infinite plane divides neither sheet.
53. “ “ $4C_2$; same as No. 52 on a smaller scale.
54. “ “ $4C_2$; the infinite plane divides the odd sheet.
55. “ “ $4C_2$; the infinite plane divides the even sheet without separating the nodes.
56. “ “ $4C_2$; the infinite plane divides the even sheet, separating one node from the other three.
57. “ “ $4C_2$; the infinite plane divides the even sheet, separating two nodes from the other two.
58. “ “ $3C_2$; a fourth node cannot be produced by deformation.
59. “ “ $3C_2$; same as No. 58 viewed from the other side of the surface.
60. “ “ $3B_3$ with real biplanes.
61. “ “ B_3 with real biplanes.
62. “ “ B_3 with imaginary biplanes.
63. “ “ $B_4 + 2C_2$ with real biplanes and real C_2's.
64. “ “ $B_4 + 2C_2$ with imaginary biplanes and imaginary C_2's.
65. “ “ $B_5 + C_2$ with real biplanes.
66. “ “ $B_6 + C_2$ with real biplanes.
67. “ “ U_6, the uniplane meeting the cubic in 3 real lines.
68. “ “ U_6, the uniplane meeting the cubic in 1 real and 2 imaginary lines.
69. “ “ U_7.
70. “ “ U_8.
71. *Cubic scroll* with distinct real pinch points.
72. “ “ with imaginary pinch points.
73. “ “ with finite coincident pinch points (Cayley's 2d species).
74. “ “ with infinite coincident pinch points.
75. *Hessian of Nos.* 53 *and* 54.
76. *Hexahedral sheet of No.* 75 for the special case in which the faces of the pentahedron are the infinite plane and four planes forming a regular tetrahedron.
77. *Hessian of No.* 58.
78. Wire model to illustrate the projection of cubics with 1, 2, 3 and 4 nodes with real pentahedrons.

QUARTIC SURFACES (*Plaster Models*).

79. *Kummer's surface* with 16 C_2 and 16 double planes (all real).
80. “ “ (8 C_2 and 8 double planes real).
81. “ “ (4 C_2 and 4 double planes real).
82. *Quartic with* $12C_2$ and 4 double planes (all real).
83. “ “ $6B_3$ and 4 double planes (all real) with real biplanes.
84. “ “ $6B_3$ and 4 double planes (all real) with imaginary biplanes.
85. “ “ $4U_6$ and 4 double planes (all real), consisting of 6 closed sheets.
86. “ “ $4U_6$ and 4 double planes (all real), consisting of 4 closed sheets.
87. “ “ 1 *double line*.
88. *Steiner's surface* with 3 double lines and 4 double planes.
89. *Wave surface for optically uni-axial crystals*, one octant of outer sheet being removed (axes 8.8 : 7.8, nearly the ratio for calc-spar, dimensions 9 cm. 8 cm.).
90. *Wave surface for optically bi-axial crystals*, outer sheet removable (axes 12.2 cm., 8.3 cm., 6.2 cm.). The ellipsoid corresponding to this surface is No. 91.
91. *Ellipsoid* corresponding to No. 90 (semiaxes 6 cm., 4.15 cm., 3.1 cm.).
92. *Wave surface for optically bi-axial crystals*, two octants, showing ellipsoidal and spheroidal lines on both sheets (semiaxes 12 cm., 9 cm., 6 cm.).
93. *Dupin's cyclide*, ring variety (dimensions 17 cm., 17 cm., 6 cm.).
94. “ “ “ “ (“ 11.5 cm., 11.5 cm., 4.5 cm.).
95. “ “ “ “ (“ 9 cm., 9 cm., 5.5 cm.).
96. “ “ horn “ (“ 18.7 cm., 15.3 cm., 5.7 cm.).
97. “ “ spindle “ (“ 11.5 cm., 11.4 cm., 9.7 cm.).
98. “ “ parabolic “ (“ 15 cm., 13.5 cm., 10 cm.).

OTHER SURFACES (*Mostly Plaster*).

99. *Central surface of an hyperboloid of one sheet:* two models show the two sheets of the surface separately, and a third represents the two together (axes of hyperboloid 5 : 2 : 1, the last being the conjugate axis).
100. *Focal surface* of a system of rays, nearly coincident with the central surface of an elliptic paraboloid; two models show the two sheets of the surface separately, and a third represents the two together.
101. *Minimal surface of the ninth order.*
102. *Surface of the twelfth order;* focal surface of rays from a luminous line after reflexion on the interior of a circular cylinder whose axis meets the line.
103. *Surface of rotation of constant positive curvature*, meridian curve meeting the axis of rotation.
104. *Surface of rotation of constant positive curvature*, meridian curve not meeting the axis of rotation.
105. *Surface of rotation of constant negative curvature*, meridian curve meeting the axis of rotation.
106. *Surface of rotation of constant negative curvature*, meridian curve not meeting the axis of rotation.
107. *Helicoidal surface of constant positive curvature.*
“ “ “ *negative* “
108. *Bianchi's surface* of constant negative curvature with plane lines of curvature.
109. *Surface of rotation of constant mean curvature* (*unduloid*) showing geodetic lines.
110. *Surface of rotation of constant mean curvature* (*nodoid*), showing geodetic lines: one model represents the surface generated by a complete period of the meridian curve, and a second represents the ring generated by the loop.
111. *Surface of rotation of constant mean curvature* (*catenoid*), showing geodetic lines.
112. *Catenoid* with lines of curvature and asymptotic curves.
113. “ of flexible brass to illustrate the development of the catenoid upon the rectilinear helicoid.
114. *Rectilinear helicoid* with lines of curvature and asymptotic curves.
115. *Circular cylindrical helicoid* with lines of curvature.
116. *Helicoidal surface* developable upon an oblate spheroid; the corresponding spheroid is No. 117 and 118.
117. *Spheroid* upon which No. 116 may be developed.
118. “ of flexible brass to illustrate the development of No. 106.
119. *Surface generated by rotating the tractrix about its asymptote*, showing geodetic lines.
120. *Surface whose equation is* $\phi = am\,(u, k)$, ϕ, u, k, being used as rectangular coordinates.
121. *Catenaries on a sphere.*
122. *Hemispherical bowl with path of a projectile*, showing also the locus of lowest points corresponding to different horizontal velocities.
123. *Cube, sphere, cone and hollow cylinder* in perspective.

III. DESCRIPTIVE GEOMETRY MODELS.

Each number consists of two boards, one horizontal and the other vertical, on which are shown the horizontal and vertical projections of one or more solids represented by accurate wooden models placed in proper position.

1. Horizontal and vertical planes hinged so that the vertical projection may be brought into horizontal position, to show the relations of the two projections to each other and to the solid.
2. *Straight lines*, with rotations and transpositions.
3. *Straight lines and arcs of circles*, with rotations and transpositions.
4. *Intersecting lines and curves*, with rotations and transpositions.
5. *Rectangles, parallelograms and circles*, with rotations.
6. *Parallelograms and circles*, with rotations.
7. *Quadrilateral*, with transpositions.
8. *Octagon*, with transpositions.
9. *Parallel circles*, with transpositions.
10. *Rolling circle*, with rotations.
11. *Sections of cylinder and cone.*
12. *Warped and helicoidal surfaces.*
13. *Cube*, with transpositions.
14. *Hexagonal pyramid*, with transpositions.
15. *Cone*, with transpositions.
16. *Hexagonal prism and cylinder*, with transpositions.
17. *Sphere and spheroid*, with transpositions.
18. *Dodecahedron and double hexagonal pyramid*, with transpositions:
19. *Double cone*, with transpositions.
20. *Cylindrical ring*, with transpositions.

INTERSECTING LINES AND SOLIDS.

21. *Intersecting lines and intersecting lines and planes.*
22. *Intersecting lines and planes.*
23. *Sections of quadrangular prism and cylinder.*
24. *Sections of cone and hexagonal pyramid.*
25. *Crystalline forms*, derived from the cube, tetrahedron and octahedron.
26. “ “ “ “ “ rhombic and pentagonal dodecahedrons.
27. *Three quadrangular prisms*, with sections.
28. *Two prisms*, with bases in the planes of projection.
29. *Three cylinders*, with sections.
30. *Three right cylinders with oblique cylinder.*
31. *Three cylinders; two prisms and a cylinder.*
32. *Three cylinders; three octagonal prisms.*
33. *Three cones*, with elliptic, parabolic and hyperbolic sections.
34. *Cone and cylinder*, in three different relative positions.

35. *Sphere and plane; sphere and cone; two spheres.*
36. *Sphere and cylinder; sphere and hexagonal prism; sphere and quadrangular prism.*
37. *Sphere and cone; sphere and cylindrical ring.*
38. *Quarter cylindrical ring*, with section; *cylindrical ring*, with six parallel sections.
39. *Cylindrical ring with cylinder and cone.*
40. *Two truncated oblique cones*, with bases in the planes of projection.

PERSPECTIVE MODELS.

41. *Straight lines.*
42. *Rectangle and circle.*
43. *Cube and cylinder.*

LIGHTS AND SHADOWS.

44. *Lines* in various positions.
45. *Quadrilateral and circular disks.*
46. *Quadrangular prism and straight line*, showing shadow of prism on the plane of projection and of line on the prism; *hexagonal prism and disk*, showing shadow of prism on the plane of projection and of disk on the prism.
47. *Cylinder and circular disk*; *oblique cylinder and circular disk*; showing shadows of cylinders on the plane of projection and of disks on the cylinder.
48. *Hexagonal pyramid and vertical disk*; *cone and horizontal disk*; showing shadows as in 47.
49. *Concave cone*; *concave hemisphere.*
50. *Sphere*; *brakes*, as an application of the sphere, hollow sphere and hollow cylinder.

ANNOUNCEMENTS.

DEGREE OF DOCTOR OF PHILOSOPHY.

Regulations adopted by the Board of University Studies.

The degree of Doctor of Philosophy and Master of Arts will be conferred in conformity with the following regulations:

1. The candidate, (after having taken his first degree), must for three years pursue university studies under conditions approved by the Board of University Studies, of which at least the last year must be as an accepted candidate studying in the philosophical department of this university.

2. He must satisfy the Board of University Studies as to his attainments by the preparation of a thesis and by passing written and oral examinations in one principal and two subsidiary subjects approved by the Board.

3. Unless permission to the contrary be given, the thesis must be presented at least three months before the candidate intends to take his degree.

4. The examination shall take place after the thesis has been approved,—the oral part of it before the Board of University Studies.

5. All theses submitted for examination must be written on paper of uniform size and description, of which a pattern may be seen in the office. Each thesis must be accompanied by an analytical table of contents. In case the author does not write a perfectly legible hand, the thesis should be copied by a type-writer,—if the subject admit of it,—or by some capable penman, or be presented in print. Theses must be bound in uniform style, with the name of the writer lettered on the back, after a pattern to be seen in the office.

6. Formal application in writing must be made to the Board of University Studies, through one of the members thereof, by students who wish to be enrolled as candidates for this degree, at least one year in advance of the anticipated time of final examination. Blank forms are provided for this purpose.

7. The above regulations as to the degree of Doctor of Philosophy and Master of Arts abrogate all previous announcements incompatible with them.

By authority of the Board,
M. WARREN, *Secretary.*

EXHIBITIONS OF WORKS OF ART.

Under the auspices of the Archæological Society of the University.

The loan exhibitions under the auspices of the Archæological Society of the University will be continued at 106 W. Monument Street, as below stated. The rooms are open on Saturdays from 2 p. m. till dark Applications for cards of admission may be sent to the Secretaries of the Society.

Saturday, December 20.—Photographs of Italian Sculpture and Painting of the Fifteenth Century; Etruscan and Italo-Greek Vases; Fragments of Antique Sculpture.

Saturdays, January 10, 17.—Photographs of Italian Sculpture and Painting of the Fourteenth and Sixteenth Centuries; Sculptures and Vases (as above).

Saturdays, January 24, 31.—Engravings of Italian, French, German and British Schools of the Eighteenth and Nineteenth Centuries.

Saturdays, February 7, 14.—Engravings of Portraits of all Schools from the Sixteenth to the Nineteenth Century. (Italian, French, German, Flemish, Dutch and British).

Saturdays, February 21, 28.—Etchings of all Schools from the Sixteenth to the Nineteenth Century.

The Society is indebted to A. L. Frothingham, Esq., for the loan of these works.

SIR WILLIAM THOMSON'S LECTURES ON MOLECULAR DYNAMICS.

The volume of Sir William Thomson's lectures on Molecular Dynamics (delivered at the Johns Hopkins University in October, 1884) is now ready for delivery.

An edition of 300 copies has been issued, and of this number all save 60 copies were subscribed for in advance of issue. The price is fixed at five dollars net. No copies will be given away or sent in exchange.

Stenographic notes of the lectures were taken by Mr. A. S. Hathaway, lately a Mathematical Fellow of the Johns Hopkins University, and these notes have been written out and carefully reproduced by the Papyrograph Plate Process. Additions have been made by Sir Wm. Thomson since his return to Europe, and an index and bibliographical notes have also been added. In all there are 336 pages, quarto.

Orders should be sent to the *Publication Agency of the University.*

STUDIES FROM THE BIOLOGICAL LABORATORY, Vol. III, No. 2 (December, 1884) is now ready. It contains papers as follows:

Notes on the Composition of the Blood and Lymph of the Slider Terrapin, (*Pseudemys rugosa*). By W. H. HOWELL.

The Origin of the Fibrin formed in the Coagulation of Blood. By W. H. HOWELL.

On the Action of Carbolic Acid, Atropia, and Convallaria on the Heart; with some observations on the Influence of Oxygenated and Non-oxygenated blood, and of Blood in various Degrees of Dilution. With one Plate. By H. G. BEYER.

The Action of Intermittent Pressure and of Defibrinated Blood upon the Blood vessels of the Frog and the Terrapin. By L. T. STEVENS and F. S. LEE.

Vol. VII, No. 2 (January, 1885), of the AMERICAN JOURNAL OF MATHEMATICS is now ready and contains the following articles:

A memoir on the Abelian and Theta functions, (chapters IV-VII, continued from Vol. V.) By A. CAYLEY.

Extrait d'une lettre de M. HERMITE.

Solution of Solvable irreducible Quintic Equations without the aid of a Resolvent Sextic. By GEORGE PAXTON YOUNG.

On the Algebra of Logic. By C. S. PEIRCE.

PROFESSOR D. C. BELL, late of Dublin, gave, on Monday, December 22, before the members of the Shakespeare Circle, a condensation of Shakespeare's comedy of The Merchant of Venice.

PUBLIC LECTURES.

The lectures of Mr. Gosse and Mr. Corson are given in the lower hall of the Peabody Institute. The other courses are given in Hopkins Hall. The lectures will begin at 5 p. m. on the days named. The doors will be opened at fifteen minutes before 5. Applications for tickets may be made in the usual manner. No general course tickets are issued; applications should state specifically the course for which tickets are desired. See regulations on page 30.

ENGLISH POETRY IN THE SEVENTEENTH CENTURY.

Edmund Gosse, Esq., of London, Clark Lecturer on English Literature in the University of Cambridge.

Six lectures on *The Rise of the Classical School of English Poetry in the Seventeenth Century*, as follows:

I. *Monday, January* 5. Poetry at the Death of Shakespeare.
II. *Wednesday, January* 7. Waller and Sacharissa.
III. *Friday, January* 9. The Exiles.
IV. *Monday, January* 12. Davenant and Cowley.
V. *Wednesday, January* 14. The Reaction.
VI. *Friday, January* 16. The Restoration.

Two lectures on the *poet Gray*, in Hopkins Hall, January 8 and 15.

SHAKESPEARE.

Professor Hiram Corson, LL. D., of Cornell University, will give a course of twenty lectures on *Shakespeare*, beginning on Friday, January 23, and continuing on successive Mondays (except February 23), Wednesdays, and Fridays till March 11.

He will present ten Plays of Shakespeare, representing the poet's early, middle, and late work, and, along with a presentation of the organic structure of the plays selected, will indicate Shakespeare's progress in the creation of character, contrast his portrayal of characters with that of Ben Jonson and other contemporary dramatists, and especially set forth his interpretation of life which is concretely resident in the plays,—in a word, he will present the plays on the human side rather than on the scholastic.

There will be two introductory lectures on Shakespeare in general. The plays will then be taken up in the following order:

(1592) Romeo and Juliet,
(1596) King John,
(1599) Much Ado about Nothing,
(1602) Hamlet,
(1606) Macbeth,
(1603–09) Coriolanus, Julius Cæsar, Antony and Cleopatra,
(1610) Winter's Tale,
(1610–11) Cymbeline.

Of the three Roman Plays, only Antony and Cleopatra will be specially treated.

In calling attention to passages in the Plays, the line-numbering of the "Globe" edition (Macmillan & Co., New York) will be cited.

THE PERPETUATION OF ANCIENT MANUSCRIPTS.

J. Rendel Harris, A. M., Associate Professor of New Testament Greek and Palæography, will give a course of eight elementary lectures on the *History of Writing*, namely, the genesis, preservation, and interpretation of written documents, beginning Tuesday, January 13, and continuing every Tuesday and Thursday till February 5.

These lectures will be addressed especially to the students of ancient languages and will be subsidiary to philological, biblical, archæological, and historical research. As far as possible, they will be illustrated by facsimiles and representations of the ancient documents to which reference is made. The following scheme will suggest approximately the order to be followed in the lectures.

I. *Tuesday, January* 13.

The art of writing in its earlier phases. The formation of alphabets. The materials employed. Dangers to which written documents have been exposed and the means used to avoid or counteract them. The development of public interest in the collection and re-publication of ancient records: *e. g.*, Assyrian, Egyptian, Greek, etc. Opportunities afforded to palæographical students in the European libraries and museums. The Record Office and École des Chartes. Possibilities of good work to be done in Baltimore.

II. *Thursday, January* 15.

On the stimulus afforded to Palæographical Science by certain epoch-making discoveries; an especial reference will be made to

α. The Rosetta Stone.
β. The first inquiry into the meaning of the Cuneiform inscriptions.
γ. The recovery of important old Hebrew remains, such as the Moabite Stone and the Siloam inscription.
δ. The recently discovered inscription of Cyrus.
ε. The researches and discoveries of the late Dr. Tischendorf.

III. *Tuesday, January* 20.

Ancient documents written on papyrus. Nature and manufacture of the Egyptian paper. Peculiar interest attaching to papyrus documents. Antiquity of its employment. Earliest known papyri. Last traces of it. Important papyri; including

α. The great Harris papyrus.
β. The Herculanean Rolls.
γ. The Hyperides MSS.
δ. Bankes' Homer papyrus.
ε. The London Psalter.
ϛ. The Paris S. Augustine.
ζ. New Testament papyri.
η. The recent finds at Medinet-el-Fayyûm.

IV. *Thursday, January* 22.

On palimpsest MSS. Antiquity of palimpsests. Character of the rescript with regard to the original. Frequency of these MSS. Division into monopsests and dipsests. Means of restoration of the lost writing. Curious self-restoration of such MSS. Important MSS. recoverable in this way:

α. Cureton's Homer.
β. The Ambrosian Plautus.
γ. Codex Ephraemi Syri.
δ. The S. Saba palimpsest of Euripides.
ε. The Codex Claromontanus.
ϛ. Codex Porphyrii of the New Testament.

Some remarks on retraced codices.

V. *Tuesday, January* 27.

Famous libraries, ancient and modern, e. g.: the Alexandrian Library; the Library at Cesarea; the British Museum; the National Library at Paris; the Vatican Library. The Libraries at Constantinople, S. Saba, Patmos, St. Catherine on Mt. Sinai. The monasteries on Mount Athos. Egyptian convents.

VI. *Thursday, January* 29.

Scribes and their peculiarities. Their manner of work, rate of pay, social position. Celebrated scribes of the middle ages. John Rhosus. Angelus Vergecius. A scribe with three fingers. Blessings and cursings.

VII. *Tuesday, February* 3.

On the determination of the date of a MS. Reasons for extreme difference of opinion among experts as to dates. Importance of reasoning from dated MSS. to undated ones. Some rules and tests. Illustration from the Teaching of the Apostles. Detection of frauds. Celebrated frauds. Simonides. Shapira.

VIII. *Thursday, February* 5.

Abbreviations found in Greek MSS. Ligatures. Short-hand. Evidence for the existence of an early short-hand. Monograms. Initials. Cryptograms. Easter-wings. Curious notes sometimes found in MSS., *e. g.*, the Codex Sangermanensis of Matthew.

35. *Sphere and plane; sphere and cone; two spheres.*
36. *Sphere and cylinder; sphere and hexagonal prism; sphere and quadrangular prism.*
37. *Sphere and cone; sphere and cylindrical ring.*
38. *Quarter cylindrical ring*, with section; *cylindrical ring*, with six parallel sections.
39. *Cylindrical ring with cylinder and cone.*
40. *Two truncated oblique cones*, with bases in the planes of projection.

PERSPECTIVE MODELS.

41. *Straight lines.*
42. *Rectangle and circle.*
43. *Cube and cylinder.*

LIGHTS AND SHADOWS.

44. *Lines* in various positions.
45. *Quadrilateral and circular disks.*
46. *Quadrangular prism and straight line*, showing shadow of prism on the plane of projection and of line on the prism; *hexagonal prism and disk*, showing shadow of prism on the plane of projection and of disk on the prism.
47. *Cylinder and circular disk; oblique cylinder and circular disk;* showing shadows of cylinders on the plane of projection and of disks on the cylinder.
48. *Hexagonal pyramid and vertical disk; cone and horizontal disk;* showing shadows as in 47.
49. *Concave cone; concave hemisphere.*
50. *Sphere; brakes*, as an application of the sphere, hollow sphere and hollow cylinder.

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4. The examination shall take place after the thesis has been approved,—the oral part of it before the Board of University Studies.

5. All theses submitted for examination must be written on paper of uniform size and description, of which a pattern may be seen in the office. Each thesis must be accompanied by an analytical table of contents. In case the author does not write a perfectly legible hand, the thesis should be copied by a type-writer,—if the subject admit of it,—or by some capable penman, or be presented in print. Theses must be bound in uniform style, with the name of the writer lettered on the back, after a pattern to be seen in the office.

6. Formal application in writing must be made to the Board of University Studies, through one of the members thereof, by students who wish to be enrolled as candidates for this degree, at least one year in advance of the anticipated time of final examination. Blank forms are provided for this purpose.

7. The above regulations as to the degree of Doctor of Philosophy and Master of Arts abrogate all previous announcements incompatible with them.

By authority of the Board,
M. WARREN, *Secretary.*

EXHIBITIONS OF WORKS OF ART.

Under the auspices of the Archæological Society of the University.

The loan exhibitions under the auspices of the Archæological Society of the University will be continued at 106 W. Monument Street, as below stated. The rooms are open on Saturdays from 2 p. m. till dark Applications for cards of admission may be sent to the Secretaries of the Society.

Saturday, December 20.—Photographs of Italian Sculpture and Painting of the Fifteenth Century; Etruscan and Italo-Greek Vases; Fragments of Antique Sculpture.

Saturdays, January 10, 17.—Photographs of Italian Sculpture and Painting of the Fourteenth and Sixteenth Centuries; Sculptures and Vases (as above).

Saturdays, January 24, 31.—Engravings of Italian, French, German and British Schools of the Eighteenth and Nineteenth Centuries.

Saturdays, February 7, 14.—Engravings of Portraits of all Schools from the Sixteenth to the Nineteenth Century. (Italian, French, German, Flemish, Dutch and British).

Saturdays, February 21, 28.—Etchings of all Schools from the Sixteenth to the Nineteenth Century.

The Society is indebted to A. L. Frothingham, Esq., for the loan of these works.

SIR WILLIAM THOMSON'S LECTURES ON MOLECULAR DYNAMICS.

The volume of Sir William Thomson's lectures on Molecular Dynamics (delivered at the Johns Hopkins University in October, 1884) is now ready for delivery.

An edition of 300 copies has been issued, and of this number all save 60 copies were subscribed for in advance of issue. The price is fixed at five dollars net. No copies will be given away or sent in exchange.

Stenographic notes of the lectures were taken by Mr. A. S. Hathaway, lately a Mathematical Fellow of the Johns Hopkins University, and these notes have been written out aud carefully reproduced by the Papyrograph Plate Process. Additions have been made by Sir Wm. Thomson since his return to Europe, and an index and bibliographical notes have also been added. In all there are 336 pages, quarto.

Orders should be sent to the *Publication Agency of the University.*

STUDIES FROM THE BIOLOGICAL LABORATORY, Vol. III, No. 2 (December, 1884) is now ready. It contains papers as follows:

Notes on the Composition of the Blood and Lymph of the Slider Terrapin, (*Pseudemys rugosa*). By W. H. HOWELL.

The Origin of the Fibrin formed in the Coagulation of Blood. By W. H. HOWELL.

On the Action of Carbolic Acid, Atropia, and Convallaria on the Heart; with some observations on the Influence of Oxygenated and Non-oxygenated blood, and of Blood in various Degrees of Dilution. With one Plate. By H. G. BEYER.

The Action of Intermittent Pressure and of Defibrinated Blood upon the Blood vessels of the Frog and the Terrapin. By L. T. STEVENS and F. S. LEE.

Vol. VII, No. 2 (January, 1885), of the AMERICAN JOURNAL OF MATHEMATICS is now ready and contains the following articles:

A memoir on the Abelian and Theta functions, (chapters IV-VII, continued from Vol. V.) By A. CAYLEY.

Extrait d'une lettre de M. HERMITE.

Solution of Solvable irreducible Quintic Equations without the aid of a Resolvent Sextic. By GEORGE PAXTON YOUNG.

On the Algebra of Logic. By C. S. PEIRCE.

PROFESSOR D. C. BELL, late of Dublin, gave, on Monday, December 22, before the members of the Shakespeare Circle, a condensation of Shakespeare's comedy of The Merchant of Venice.

PUBLIC LECTURES.

The lectures of Mr. Gosse and Mr. Corson are given in the lower hall of the Peabody Institute. The other courses are given in Hopkins Hall. The lectures will begin at 5 p. m. on the days named. The doors will be opened at fifteen minutes before 5. Applications for tickets may be made in the usual manner. No general course tickets are issued; applications should state specifically the course for which tickets are desired. See regulations on page 30.

ENGLISH POETRY IN THE SEVENTEENTH CENTURY.

EDMUND GOSSE, ESQ., of London, Clark Lecturer on English Literature in the University of Cambridge.

Six lectures on *The Rise of the Classical School of English Poetry in the Seventeenth Century*, as follows:

I. *Monday, January* 5. Poetry at the Death of Shakespeare.
II. *Wednesday, January* 7. Waller and Sacharissa.
III. *Friday, January* 9. The Exiles.
IV. *Monday, January* 12. Davenant and Cowley.
V. *Wednesday, January* 14. The Reaction.
VI. *Friday, January* 16. The Restoration.

Two lectures on the *poet Gray*, in Hopkins Hall, January 8 and 15.

SHAKESPEARE.

PROFESSOR HIRAM CORSON, LL. D., of Cornell University, will give a course of twenty lectures on *Shakespeare*, beginning on Friday, January 23, and continuing on successive Mondays (except February 23), Wednesdays, and Fridays till March 11.

He will present ten Plays of Shakespeare, representing the poet's early, middle, and late work, and, along with a presentation of the organic structure of the plays selected, will indicate Shakespeare's progress in the creation of character, contrast his portrayal of characters with that of Ben Jonson and other contemporary dramatists, and especially set forth his interpretation of life which is concretely resident in the plays,—in a word, he will present the plays on the human side rather than on the scholastic.

There will be two introductory lectures on Shakespeare in general. The plays will then be taken up in the following order:

(1592) Romeo and Juliet,
(1596) King John,
(1599) Much Ado about Nothing,
(1602) Hamlet,
(1606) Macbeth,
(1603–09) Coriolanus, Julius Cæsar, Antony and Cleopatra,
(1610) Winter's Tale,
(1610–11) Cymbeline.

Of the three Roman Plays, only Antony and Cleopatra will be specially treated.

In calling attention to passages in the Plays, the line-numbering of the "Globe" edition (Macmillan & Co., New York) will be cited.

THE PERPETUATION OF ANCIENT MANUSCRIPTS.

J. RENDEL HARRIS, A. M., Associate Professor of New Testament Greek and Palæography, will give a course of eight elementary lectures on the *History of Writing*, namely, the genesis, preservation, and interpretation of written documents, beginning Tuesday, January 13, and continuing every Tuesday and Thursday till February 5.

These lectures will be addressed especially to the students of ancient languages and will be subsidiary to philological, biblical, archæological, and historical research. As far as possible, they will be illustrated by facsimiles and representations of the ancient documents to which reference is made. The following scheme will suggest approximately the order to be followed in the lectures.

I. *Tuesday, January* 13.

The art of writing in its earlier phases. The formation of alphabets. The materials employed. Dangers to which written documents have been exposed and the means used to avoid or counteract them. The development of public interest in the collection and re-publication of ancient records: *e. g.*, Assyrian, Egyptian, Greek, etc. Opportunities afforded to palæographical students in the European libraries and museums. The Record Office and École des Chartes. Possibilities of good work to be done in Baltimore.

II. *Thursday, January* 15.

On the stimulus afforded to Palæographical Science by certain epoch-making discoveries; an especial reference will be made to

α. The Rosetta Stone.
β. The first inquiry into the meaning of the Cuneiform inscriptions.
γ. The recovery of important old-Hebrew remains, such as the Moabite Stone and the Siloam inscription.
δ. The recently discovered inscription of Cyrus.
ε. The researches and discoveries of the late Dr. Tischendorf.

III. *Tuesday, January* 20.

Ancient documents written on papyrus. Nature and manufacture of the Egyptian paper. Peculiar interest attaching to papyrus documents. Antiquity of its employment. Earliest known papyri. Last traces of it. Important papyri; including

α. The great Harris papyrus.
β. The Herculanean Rolls.
γ. The Hyperides MSS.
δ. Bankes' Homer papyrus.
ε. The London Psalter.
ϛ. The Paris S. Augustine.
ζ. New Testament papyri.
η. The recent finds at Medinet-el-Fayyûm.

IV. *Thursday, January* 22.

On palimpsest MSS. Antiquity of palimpsests. Character of the rescript with regard to the original. Frequency of these MSS. Division into monopsests and dipsests. Means of restoration of the lost writing. Curious self-restoration of such MSS. Important MSS. recoverable in this way:

α. Cureton's Homer.
β. The Ambrosian Plautus.
γ. Codex Ephraemi Syri.
δ. The S. Saba palimpsest of Euripides.
ε. The Codex Claromontanus.
ϛ. Codex Porphyrii of the New Testament.

Some remarks on retraced codices.

V. *Tuesday, January* 27.

Famous libraries, ancient and modern, e. g.: the Alexandrian Library; the Library at Cesarea; the British Museum; the National Library at Paris; the Vatican Library. The Libraries at Constantinople, S. Saba, Patmos, St. Catherine on Mt. Sinai. The monasteries on Mount Athos. Egyptian convents.

VI. *Thursday, January* 29.

Scribes and their peculiarities. Their manner of work, rate of pay, social position. Celebrated scribes of the middle ages. John Rhosus. Angelus Vergecius. A scribe with three fingers. Blessings and cursings.

VII. *Tuesday, February* 3.

On the determination of the date of a MS. Reasons for extreme difference of opinion among experts as to dates. Importance of reasoning from dated MSS. to undated ones. Some rules and tests. Illustration from the Teaching of the Apostles. Detection of frauds. Celebrated frauds. Simonides. Shapira.

VIII. *Thursday, February* 5.

Abbreviations found in Greek MSS. Ligatures. Short-hand. Evidence for the existence of an early short-hand. Monograms. Initials. Cryptograms. Easter-wings. Curious notes sometimes found in MSS., *e. g.*, the Codex Sangermanensis of Matthew.

PHONETICS AND PRONUNCIATION.

A. Melville Bell, Esq., of Washington, formerly of London, author of "Visible Speech," will give four lectures on *Phonetics*, as follows:

I. *Tuesday, February* 10.

Enumeration of the varieties of speech elements. Alphabetic Conference in 1854 and its results. Phonetic and pictorial words. Early English pronunciation. Specimen of Shakesperian English. Spelling. Methods of phonetic initiation. Visible speech. Its applicability to all languages. Varieties of Alphabets. Modern increase in the number of discriminated sounds. The whole amount of phonetic variety. Special symbols indispensable. Descriptive names of the physiological letters. Symbols for thirty-six vowels, and forty-eight consonants. All produced from nine elementary symbols. Exercises.

II. *Thursday, February* 12.

Voice sounds. Breath sounds. Mouth sounds. Inhalations. Suctions. Resemblance of lowland Scotch to Early English. Specimen of the vernacular of Burns. How the visible speech category of sounds was formed. Previous classifications and nomenclature of vowels. Glossotype. International Phonetics. Natural scales of vowel sounds. The names of the vowel symbols translated into phonetic action. Exercises.

III. *Tuesday, February* 17.

Prejudice against novelty. University College, London. Relation of the vowel symbols to mouth-cavities. Development of consonants from vowels. The names of the consonant symbols translated into phonetic action. Correspondence between the sounds of *L* and *V*. Consonant percussions. Clicks. Non-vocal nasal consonants. Throat consonants. Exercises.

IV. *Thursday, February* 19.

Glides. Development of vowels from consonants. Sounds of *R*. The American *R*. Consonants in combinations. Sounds of *Ch* and *J*. The Tones of Speech. Dialectic and professional tunes. Significance of tones. Language interpreted by tones. Tests of ear. The source of expressiveness in articulate sounds. Unused speech-material. Speech-reading by the deaf.

Mr. Bell will also give two lectures on *English Pronunciation*, as follows:

V. *Tuesday, February* 24.

English pronunciation and the pronunciation of English. Characteristic excellences, and the means to their attainment. Schemes of sounds in pronouncing dictionaries. Divergence in American and English phonetic practice. Elements. Syllables. Accent. Dialects. Foreign words. Oral action, &c.

VI. *Thursday, February* 26.

Defects and peculiarities of speech illustrated, in a corrective lesson to a "shadow class" of students.

FRENCH LITERATURE.

M. Rabillon, Lecturer on French Literature, will continue his course of lectures (*in French*), on successive Saturdays till further notice.

SCHEDULE OF DATES OF PUBLIC LECTURES.

Mondays (Jan. 5–12), Mr. Gosse.
" (Jan. 26–Mar. 9, except Feb. 23), Mr. Corson.
Tuesdays (Jan. 13–Feb. 3), Mr. Harris.
" (Feb. 10–24), Mr. Bell.
Wednesdays (Jan. 7–14), Mr. Gosse.
" (Jan. 28–Mar. 11), Mr. Corson.
Thursdays (Jan. 15–Feb. 5), Mr. Harris.
" (Feb. 12–26), Mr. Bell.
Fridays (Jan. 9–16), Mr. Gosse.
" (Jan. 23–Mar. 6), Mr. Corson.
Saturdays (till further notice), M. Rabillon.

PROCEEDINGS OF SOCIETIES.

Scientific Association.

December 3.—Sixtieth regular meeting. Professor Martin in the chair. Forty-two persons present.

Papers read:

Why does One Attack of many Infectious Diseases Protect from a Second? by G. M. Sternberg. (*See p.* 31.)

An Account of some additional Geometrical Models, by W. E. Story. (*See p.* 36.)

A simple Apparatus which enables students to Determine the Equivalents of some of the Elements, by H. N. Morse.

January 7.—Sixty-first regular meeting. Professor Martin in the chair. Fifty persons present.

Papers read:

On the Seat of Electromotive Force in the Voltaic Cell, by C. A. Perkins.

A Measure of the Attractive Force exerted by Isomeric and Homologous Molecules. by I. Remsen.

Is Scientific Psychic Research Practicable? by G. S. Hall.

Philological Association.

December 5.—Fifty-seventh regular meeting. Professor Gildersleeve in the chair. Thirty-nine members present.

Papers read:

Some account of King Alfred's Anglo-Saxon Version of the *De Consolatione Philosophiae* of Boethius, by J. W. Bright. (*See p.* 32.)

On the Etymology of Elixir, by C. Adler. (*See p.* 33.)

January 9.—Fifty-eighth regular meeting. Professor Gildersleeve in the chair. Thirty-five members present.

Papers read:

On the Dialects of North Germany, by E. H. Spieker.

The Lessons of the Peloponnesian War as developed in the Speeches of Thucydides, by A. H. Huizinga.

On the Etymology of Hybrid, by M. Warren.

Historical and Political Science Association.

November 21.—Dr. H. B. Adams in the chair.

Principles of Graduate and Undergraduate Work in History and Politics, by H. B. Adams and J. F. Jameson.

Principles of Graduate and Undergraduate Work in Political Economy, by R. T. Ely.

December 5.—Dr. H. B. Adams in the chair.

The Colony at Saybrook, Connecticut, by C. H. Levermore.

The Quaker Settlement at Ellicott's Mills, by H. B. Adams.

Canadian Studies in Local History, by E. R. L. Gould.

Work of The Historical and Political Science Association in the University of Nebraska, by W. H. Lichty.

December 12.—Dr. H. B. Adams in the chair.

Contemporary Socialism, by R. T. Ely.

Studies in Germanic Folk-Lore, by E. F. Leyh.

Recent changes in the Historical and Political courses at Yale College, by C. H. Levermore.

December 17.—Dr. H. B. Adams in the chair.

The New Jersey Proprietors, by Austin Scott.

Laughlin's Revision of Mill's Political Economy, by R. T. Ely.

Metaphysical Club.

December 16.—Fortieth regular meeting. Professor Hall in the chair. Twenty-five members present.

Papers read:

A case of Visualized Number Forms, by G. E. de Steiguer.

A case of Contagious Frenzy, by J. C. C. Newton.

Observations on the Psychology of Reading, by A. H. Gross.

Final Causes, by A. T. Bruce.

An Educational Study, by C. H. Levermore.

Report on Visual Localization and the Sensation of Heat, by H. H. Donaldson.

Archæological Society.

December 20.—Thirty-five persons present.

On the American School of Archæology at Athens, by A. M. Wilcox.

Dr. Wilcox gave an account of the situation of the school, of his work there last year, and of its future prospects.

On the Great Seal of Maryland, by C. C. Hall.

This paper discusses the date of this Seal recently found at Annapolis, which was one of those sent over from England under Lord Baltimore.

On Greek and Etruscan Vases, by A. Emerson.

This address was illustrated by examples in two collections on exhibition in the rooms of the society, loaned by Mr. A. L. Frothingham and Mrs. Langdon Williams.

JOHNS HOPKINS UNIVERSITY CIRCULARS

Published with the approbation of the Board of Trustees

VOL. IV.—No. 37.] BALTIMORE, MARCH, 1885. [PRICE, 10 CENTS.

CALENDAR, 1884-85.

Tuesday, September 23.	**Current Academic Year Began.**
Tuesday, September 30.	**Instructions Resumed.**
Wednesday, December 24—Saturday, January 3.	**Christmas Recess.**
Monday, February 23.	**Commemoration Day.**
Friday, April 3—Monday, April 6 (inclusive.)	**Spring Recess.**
Monday, June 8.	**Examinations for Matriculation Begin.**
Friday, June 12.	**Term of Instruction Closes.**

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The Johns Hopkins University Circulars are printed by Messrs. JOHN MURPHY & CO., 182 West Baltimore Street, Baltimore, from whom single copies may be obtained. They may also be procured from Messrs. CUSHINGS & BAILEY, No. 262 West Baltimore Street, Baltimore.

STANDING ANNOUNCEMENTS.

JOHNS HOPKINS UNIVERSITY.

Opened for Instruction in 1876.

The Johns Hopkins University was founded by the munificence of a citizen of Baltimore, Johns Hopkins, who bequeathed the most of his large estate for the establishment of a University and a Hospital. It was intended that these institutions should coöperate in the promotion of medical education. The Hospital buildings are approaching completion.

The foundation of the University is a capital, in land and stocks, estimated in value at more than $3,000,000; the capital of the Hospital is not less in amount.

The University was incorporated under the laws of the State of Maryland, August 24, 1867. Power to confer degrees was granted by the Legislature in 1876.

Suitable buildings have been provided in Baltimore at the corner of Howard and Little Ross Sts., and are furnished with the necessary apparatus and books.

Academic Staff, 1884–5.

Daniel C. Gilman, LL. D., *President of the University.*

J. J. Sylvester, F. R. S., D. C. L., *Professor (Emeritus) of Mathematics.*

Basil L. Gildersleeve, PH. D. LL. D., *Professor of Greek.*

G. Stanley Hall, PH. D., *Professor of Psychology and Pedagogics.*

Paul Haupt, PH. D., *Professor of the Shemitic Languages.*

H. Newell Martin, DR. SC., A. M., *Professor of Biology and Director of the Biological Laboratory.*

Charles D. Morris, A. M., *Collegiate Professor of Latin and Greek.*

Simon Newcomb, LL. D., *Professor of Mathematics and Astronomy.*

Ira Remsen, M. D., PH. D., *Professor of Chemistry and Director of the Chemical Laboratory.*

Henry A. Rowland, PH. D., *Professor of Physics and Director of the Physical Laboratory.*

William H. Welch, M. D., *Professor of Pathology.*

John S. Billings, M. D., *Lecturer on Hygiene.*

Hiram Corson, A. M., LL. D., *Lecturer on English Literature.*

Edmund Gosse, *Lecturer on English Literature.*

George S. Morris, A. M., PH. D., *Lecturer on the History of Philosophy.*

Léonce Rabillon, BACH. ÈS LETT., *Lecturer on French Literature.*

William Thomson, LL. D., *Lecturer on Molecular Dynamics.*

Herbert B. Adams, PH. D., *Associate Professor of History.*

Maurice Bloomfield, PH. D., *Associate Professor of Sanskrit.*

William K. Brooks, PH. D., *Associate Professor of Morphology and Director of the Chesapeake Zoölogical Laboratory.*

Thomas Craig, PH. D., *Associate Professor of Applied Mathematics.*

A. Marshall Elliott, A. M., *Associate Professor of Romance Languages.*

J. Rendel Harris, A. M., *Associate Professor of New Testament Greek and Palaeography.*

Harmon N. Morse, PH. D., *Associate Professor of Chemistry and Sub-Director of the Chemical Laboratory.*

William E. Story, PH. D., *Associate Professor of Mathematics.*

Minton Warren, PH. D., *Associate Professor of Latin.*

William Hand Browne, M. D., *Librarian and Associate in English.*

William T. Councilman, M. D., *Associate in Pathology.*

Richard T. Ely, PH. D., *Associate in Political Economy.*

Fabian Franklin, PH. D., *Associate in Mathematics.*

Edward M. Hartwell, M. D., PH. D., *Associate in Physical Training and Director of the Gymnasium.*

J. Franklin Jameson, PH. D., *Associate in History.*

Arthur L. Kimball, PH. D., *Associate in Physics.*

Philip R. Uhler, *Associate in Natural History.*

George H. Williams, PH. D., *Associate in Mineralogy.*

Henry Wood, PH. D., *Associate in German.*

Charles F. Raddatz, *Examiner in German.*

Edward H. Spieker, PH. D., *Instructor in Latin and Greek.*

Henry A. Todd, PH. D., *Instructor in Romance Languages.*

Alfred Emerson, PH. D., *Instructor in Classical Archæology.*

George Hempl, A. B., *Assistant in German.*

William H. Howell, PH. D., *Assistant in Biology.*

Edward H. Keiser, PH. D., *Assistant in Chemistry.*

Charles A. Perkins, PH. D., *Assistant in Physics.*

Hugh Newell, *Instructor in Drawing.*

Charles L. Woodworth, Jr., *Instructor in Elocution.*

Otto Lugger, *Curator of the Biological Museum*

PLAN OF THE CIRCULARS.

The Johns Hopkins University Circulars are published at convenient intervals during the academic year for the purpose of communicating intelligence to the various members of the University in respect to work which is here in progress, as well as for the purpose of promulgating official announcements from the governing and teaching bodies. During the current academic year, successive circulars may be expected in the months of November, December, January, March, April, May, and June, to be followed at the close of the year by an index.

Although these circulars are designed for the members of the University, they have frequently been called for by institutions and libraries at a distance, and also by individuals who are interested in the literary and scientific activity of this University. Subscriptions and exchanges are therefore received.

TERMS OF SUBSCRIPTION.

For the current year, 1884–5, $1.

For the year 1883–4, (140 pp. in cloth covers), $1.50.

For the year 1882–3, (156 pp. in cloth covers), $3.

For the years 1880–2, (250 pp. in cloth covers), $5.

Subscribers to the Circulars will also receive the Annual Register and Report of the University.

All subscriptions should be addressed to the "Publication Agency of the Johns Hopkins University."

Communications for the Circulars should be sent in prior to the first day of the month in which they are expected to appear.

PUBLIC LECTURES.

Notice in Respect to the Admission of the Public.

In answer to inquiries, and in correction of some current misapprehensions, the following statements are made in respect to the public lectures given in the Johns Hopkins University.

These courses are academic lectures, designed primarily for the members of the University, and supplementary to the regular class-room work of the students.

As the members of the University rarely require the entire room, the Trustees have taken great pleasure in inviting other persons, not connected with the University, to attend.

As these lectures are not intended for popular entertainment, but for the instruction of students, those persons first receive tickets, in most cases, who are known to be especially interested in a particular course,—ladies as well as gentlemen.

There is no general course ticket issued. Applications should state specifically the course for which tickets are desired. Programmes and other current information pertinent to university work may be found in the *University Circulars*, sent to subscribers on the payment of one dollar per annum, by the Publication Agency of the University.

The usage of giving personal notification has been discontinued, and those therefore who are interested in such announcements should hereafter consult the *Circulars.*

It will save much delay if applications for tickets and inquiries on these and other routine matters are addressed not to individuals but to the Johns Hopkins University, *by postal card*, and answers will be promptly returned by mail. Personal applications consume time needlessly.

☞ The lectures begin at 5 o'clock *punctually.* The doors of the hall are opened at fifteen minutes before 5, and the lectures do not exceed an hour in the delivery.

PUBLICATIONS ISSUED UNDER THE AUSPICES OF THE UNIVERSITY.

I. American Journal of Mathematics.

The publication of this journal commenced in 1878, under the editorial direction of Professor Sylvester, and is now conducted by Professor Simon Newcomb as Editor, and Dr. T. Craig as Associate Editor. Six volumes of about 400 pages each have been issued, and the seventh is in progress. It appears quarterly, in the quarto form. Subscription $5 per year. Single numbers $1.50.

II. American Chemical Journal.

This journal was commenced in 1879, with Professor Remsen as editor. Five volumes of about 450 pages each have been issued, and the sixth is in progress. It appears bi-monthly. Subscription $3 per year. Single numbers 50 cts.

III. American Journal of Philology.

The publication of this journal commenced in 1880, under the editorial direction of Professor Gildersleeve. Four volumes of about 570 pages each have been issued, and the fifth is in progress. It appears four times yearly. Subscription $3 per volume. Single numbers $1.00.

IV. Studies from the Biological Laboratory.

[*Including the Chesapeake Zoological Laboratory.*]

The publication of these papers commenced in 1879, under the direction of Professor Martin, with the assistance of Dr. W. K. Brooks. Two volumes of about 500 pages, octavo, and 40 plates each, have been issued, and the third is in progress.

V. Studies in Historical and Political Science.

The publication of these papers was begun in 1882, under the editorial direction of Dr. H. B. Adams. A first series of 470 pages and a second of 630 pages are now completed and a third series is in progress. Subscription $3 per volume.

The following publications are also issued by the University:

The University Circulars. Subscription $1 per year.

The Annual Report presented by the President to the Board of Trustees reviewing the operations of the University during the past academic year.

The Annual Register giving the list of officers and students and stating the regulations of the University. Published at the close of the academic year.

The University Circulars, Annual Report, and Annual Register will be sent by mail for one dollar per annum.

All communications in respect to these publications should be addressed to the "Publication Agency of the Johns Hopkins University," Baltimore, Maryland.

In addition to the serials above named, a few copies are for sale of the papers named below:

Studies in Logic. By members of the Johns Hopkins University. C. S. Peirce, Editor. (Boston: Little, Brown & Co.) 1883. 123 pp., 12o. $2.

The Development and Propagation of the Oyster in Maryland By W. K. Brooks. 1884. 193 pp., 4o. 13 plates and 3 maps. $5.

On the Mechanical Equivalent of Heat. By H. A. Rowland. 1880. 127 pp., 8o. $1.50.

New Testament Autographs. By J. Rendel Harris. 1882. 54 pp., 8o. 4 plates. 50 cents.

Sir William Thomson's Lectures on Molecular Dynamics. Delivered at the Johns Hopkins University in October, 1884. Reproduced from stenographic notes by the papyrograph plate process. 370 pp., 4to. $5.00.

THE BENEFITS WHICH SOCIETY DERIVES FROM UNIVERSITIES.

THE ANNUAL ADDRESS BEFORE THE JOHNS HOPKINS UNIVERSITY, DELIVERED IN BALTIMORE, FEBRUARY 23, 1885,

By DANIEL C. GILMAN,
President of the University.

ies and Gentlemen:

o be concerned in the establishment and lopment of a university is one of the est and most important tasks ever imposed a community or on a set of men. It is an ertaking which calls for the exercise of the ost care, for combination, coöperation, liber- r, inquiry, patience, reticence, exertion and r ceasing watchfulness. It involves per- ities, delays, risks. Mistakes cannot possibly voided; heavy responsibility is never absent. history and experience light up the prob- ; hope and faith give animation to the lers when they are weary and depressed. ply moved by these considerations, I desire ring before you, my colleagues in this work, out whose labors all would be a failure, who are Trustees, and you who are teachers, re the citizens of Baltimore, and before this pany of students pressing forward to take places of authority in the work of educa- n and administration—before you all, my ds, I wish to suggest some aspects of uni- ity life, which, if not new, may perhaps be d in terms which are fresh, with illustrations n from our own experience.

ask you to reflect at this time on THE RELATION NIVERSITIES TO THE PROGRESS OF CIVILIZA- , and I begin by assuming that we are agreed tantially on the meaning of both these terms.

word university, as applied to a learned oration, is several hundred years old, and ll times and lands has embodied the idea of highest known agency for the promotion of vledge and the education of youth. Civiliza- is a new word, hardly introduced a cen- ago, though the idea which it embodies is ld as organic society. Guizot, to whose ence we owe the popularity of this term, ls its formal definition, declaring in general s that civilization is the grand emporium of a people, in which all its wealth, all the elements of its life, all the powers of its existence are stored up. "Wherever," as he goes on to say, "the exterior condition of man becomes enlarged, quickened or improved, wherever the intellectual nature of man distinguishes itself by its energy, brilliancy and its grandeur; wherever these two signs concur, and they often do so, notwithstanding the gravest imperfections in the social system, there man proclaims and applauds civilization." Assuming, then, that by university the highest school is understood, and by civilization the highest welfare of mankind, let us inquire into the influence which the advancement of knowledge by means of superior educational establishments has exerted or may exert upon the progress of society.

A little reflection will remind us of five great agencies by which modern Christian civilization is helped forward: first THE FAMILY, unit of our social organization, recognized by Aristotle as the basis of society, and styled by modern philosophers "the focus of patriotism" (Lieber) and the very "starting point of social morality" (Maurice); next, TRADE or COMMERCE, the exchange of one man's products for another's, the traffic between communities and nations; third, LAW and CUSTOM, written and unwritten, the enforcement of duties, and defense of rights, the equitable adjustment of conflicting claims; fourth, RELIGION, the acknowledgment of personal responsibility to an infinite and all controlling Power. The last to be named is KNOWLEDGE, the recorded observations and experience of our race in ancient and in modern times, or in other words SCIENTIA, science in its broadest significance.

These five influences working in dwelling houses, market places, state houses, churches, libraries and schools, control our modern life; and that state of society is the best, in which domestic virtue, mercantile honor and the freedom of exchange, obedience to law, pure and undefiled religion, and the general diffusion of knowledge, are the dominant characteristics. We are only concerned at present with the last of these five factors.

The means by which our race has acquired knowledge and preserved its experience are manifold. The inhabited world is a great laboratory, in which human society is busily experimenting. Observation, exploration, and reflection have been allied in interpreting the physical characteristics of the globe, ever since the primeval law, Subdue the earth, was heard by primitive man; experiments in social organization have also been made on a colossal scale, and in little microcosms; war has taught its pitiful lessons; superstition, irreligion, vice and crime as well as literature, art, law, religion and philosophy have all been teachers; customs, traditions, epics, creeds, codes, treaties, inscriptions, parchments, books, pyramids, temples, statues, museums, schools, pulpits, platforms have all been employed to perpetuate and diffuse the knowledge which has been acquired; but ever since Europe emerged from the darkness of the middle ages, UNIVERSITIES have been among the most potent of all agencies for the advancement and promulgation of Learning. Their domain, the republic of letters, has been wider than the boundaries of any state; their citizens have not been restricted to any one vocabulary; their acquisitions have been hid in no crypt. They have gathered from all fields and distributed to all men. Themes the most recondite, facts the most hidden, relations the most complex have been sought out and studied, that if possible the laws which govern the world might be discovered, and man made better.

In one of our halls, there hangs a diagram which I never pass without pausing to think of its significance, listening as I would before the sphinx to discover if it has any message for me. It contains a list of European universities founded since the dawn of modern states,—a period of more than seven centuries, a list of over two hundred names. Every state in Europe, every great city, has its high school. Popes, emperors, kings and princes have been their founders; ecclesiastics, reformers, republics, municipalities, private citizens, munificent women have contributed to their maintenance. Wherever European civilization has gone, the idea of the university has been carried with it, to North and South America, to Australia, even to India, China and Japan; it came with the Virginians to Williamsburg, with the New Englanders to Cambridge and New Haven; it was planted in California before there was an organized state on the Pacific slope.

The idea is often vague, sometimes perverted, commonly half-developed, at times inflated,—nevertheless it contains this principle of life, that in every civilized community there must be a high school, capping, crowning, binding all other institutions for the advancement of learning.

Allow me to turn your attention to some historical illustrations.

Notwithstanding the great renown of Charlemagne, greatest of monarchs between Caesar and Napoleon, the fact that his empire was founded upon the principle of superior education is not so familiar; but a recent writer (Mr. Mullinger) has given us an instructive essay on the schools of Charles the Great and a still more recent writer, (Mr. R. L. Poole) has made a study of their influence. "If his reign marks the dividing line between ancient and modern history," says the latter, "it is not only by virtue of its political facts but also because he begins the education of the Northern races,—fitting them in time to rule the world as the Romans had done before them."

A monk of St. Gall has preserved for us what purports to be an authentic account of the mode in which learning was introduced into the Frankish empire, and although the extract is long I am sure it will not weary you, as I read from the translation of Mr. Poole.

"*When*," says the monk, "*the illustrious Charles had begun to reign alone in the western parts of the world, and the study of letters was everywhere well-nigh forgotten, in such sort that the worship of the true God declined, it chanced that two Scots from Ireland lighted with the British merchants on the coast of Gaul, men learned without compare, as well in secular, as in sacred writings; who, since they shewed nothing for sale, kept crying to the crowd that gathered to buy, If any man is desirous* *of wisdom, let him come to us and receive it; for we have it to sell. This therefore they declared they had for sale, since they saw the people to traffic not in gifts but in saleable things, so that they thus might either urge them to purchase wisdom like other goods or, as the events following shew, turn them by such declaration to wonder and astonishment. At length their cry being long continued was brought by certain that wondered at them or deemed them mad, to the ears of Charles, the king, always a lover and most desirous of wisdom: who, when he had called them with all haste into his presence, enquired if, as he understood by report, they had wisdom verily with them. Yea, said they, we have it and are ready to impart to any that rightly seek it in the name of the Lord. When therefore he had enquired what they would have in return for it, they answered, Only proper places and noble souls, and such things as we cannot travel without, food and wherewith to clothe ourselves. Hearing this he was filled with great joy."*

Several instances in modern history may be cited, in each of which the close of a great civil commotion has been marked by the foundation of a university. One of them is quite familiar. A little more than three hundred years ago, Leyden, so lately freed from the horrors of a siege, "so lately the victim of famine and pestilence, had crowned itself with flowers." The university was to be inaugurated. In the grand procession rode a female figure, the Holy Gospel, attended by Four Evangelists; then came other allegorical figures, emblematic of Law, Medicine and the Liberal Arts, and then the magistrates and dignitaries. Down the Rhine floated the semblance of Apollo and the Muses, and each Professor, as he advanced, "was kissed by Apollo and all the nine muses in turn," whose salutations found further expression in "an elegant Latin poem." I have taken these statements, as you doubtless surmise, from the pages of Motley, to show you the enthusiasm of the Low Countries in respect to their university; but a truer impression of the work then inaugurated would be given by recounting the roll of the great men who have taught in that university and of the great scholars whom they have trained. Grotius, Descartes, Scaliger, Boerhave, Wyttenbach, Arminius and Gomar were among the early scholars who resided in Leyden, and the list might be extended until it reached our own contemporaries and our own countrymen.

A few years earlier, when the Reformation in England was nearly completed, Henry the Eighth re-organized the University of Cambridge and laid the foundations of that splendid college, which might be called a university in itself, if ever a college could claim the more comprehensive name, Trinity College, which before the century had passed, trained for the world that great triumvirate whose statues glorify the approach to the chapel, Isaac Barrow, Lord Bacon, and Sir Isaac Newton, *qui genus humanum ingenio superavit.*

The foundation of the University of Berlin is a noteworthy modern instance of the erection of a great high-school, in a time of national sorrow. The story has often been given and was recently made the opening passage in an inaugural address by Helmholz. Prussia had been overrun by France, the resources of the state were almost exhausted, but Frederick William the Third, led on by William Von Humboldt, Stein, and other great intellects, determined to infuse new spirit into a despondent people, by conferring on them the greatest benefit which it was in his power to bestow, a university, founded on such a liberal plan, that it rose at once to the very front rank.

So within our recollection, that monarch's greater son, the Emperor William, when Strassburg had been reclaimed by Germany, determined that it should be the seat of a university, and already that new foundation stands among the strongest and best of German high-schools.

These examples of universities founded each of them at the close of a sharp social crisis, often occur to my mind when I remember that our foundation was projected at the close of a civil war, and was established in the firm belief that it would bind together in the love of Literature and Science, all classes and all creeds. A physician who has lately died in communion with the Roman Catholic Church, has often said to me, "I tell everybody that there is one thing on which we can all agree, and that is the university," and another, of the same religious creed, has just written me, "I sincerely hope to see your prediction as to all Christian forces come true. Life is too short, and there is too much good to be done, to have any force or energy wasted in barren controversy."

I have made these historical allusions, most of which I am well aware are familiar, in order to raise the questions: Why is it that universities are so highly esteemed? What are the advantages which follow their foundation? Remembering that a university is the best organization for the liberal education of individuals, and the best organization for the advancement of science, apply the double test,—what is done for personal instruction, and what is done for the promotion of knowledge, and you will be able to judge any institution which assumes this name.

Ask, first, is it a place of sound education? Are the youth who are trained within its walls, honest lovers of the truth,—are they learned, are they ready, are they trustworthy? When they leave the academic classes, do they soon find a demand for their services? Do they rise in professional life? Are they sought for as teachers? Do they show aptitude for mercantile, administrative, or editorial life? Do they acquit themselves with credit in the public service? Do the books they write find publishers? Do they win repute among those who have added to the sum of human knowledge? Have they the power of enjoying literature, music, art? Can they apply the lessons of history to the problems of our day? Are they always eager to enlarge their knowledge? Do they become conservative members of society, seeking for progress by steady improvements rather than by the powers of destruction and death? Are they useful, courteous, coöperative citizens, in all the relations of life? Do the charities, the churches, the schools, the public affairs of the community receive their constant consideration? Are there frequent manifestations among them, of unusual ability in science, in literature, in oratory, in administration? As the roll of the alumni increases and the graduates are counted by hundreds and not by scores, does it appear that a large proportion are men of honorable, faithful, learned and public spirited character? These are the questions by which as the years go on, a university is to be tested, or to sum all questions in one, is it proved to be a place for the development of manliness?

I beg leave to dwell a little longer upon this text, because I think there is danger of its importance being overlooked. The material resources of a university, the aggregate numbers who attend its courses, its numerous buildings, its great collections appeal to everybody,—only those who look at results, are competent to give a conclusive opinion, and their opinion cannot be formed in one decade. A generation is the briefest period for a fair review. When the year of our Lord 1900 comes, this foundation will be a quarter of a century old. To that remote tribunal we appeal for judgment on our work of to-day. But we may anticipate this final verdict, and ascertain by our own inspection and inquiry what is done in any institution for the education of youth, what opportunities are afforded, how those advantages are regarded by the most intelligent young men, and what kind of scholarship is developed at the termination of the academic course.

Here let me protest against the common method of estimating intellectual work by numerical standards alone. I have heard it said that some men are possessed by a statistical devil. They can only think in figures; they will ask, in respect to a new acquaintance, how much is he worth; of a library how many volumes; of an orchestra how many pieces; of a college how many students. I have known the expenses of an institution made a dividend, and the number of scholars the divisor, the quotient representing the cost of each pupil. All this is wrong, absolutely and wholly wrong. If such a standard were allowable, the largest number of scholars taught by the cheapest teacher would be the greatest success. It is not the number but the quality of students which determine the character of a high school. It is important to count; it is better to weigh.

Having spoken of what the university does for individuals, I add that it has a second function. It benefits associated as well as individual man. It renders services to the community which no demon of statistics can ever estimate, no mathematical process ever develop. These functions may be stated as the acquisition, conservation, refinement and distribution of knowledge.

These carefully chosen words I proceed to explain.

First, it is the business of a university to advance knowledge; every professor must be a student. No history is so remote that it may be neglected; no law of mathematics is so hidden that it may not be sought out; no problem in respect to physics is so difficult that it must be shunned. No love of ease, no dread of labor, no fear of consequences, no desire for wealth will divert a band of well chosen professors from uniting their forces in the prosecution of study. Rather let me say that there are heroes and martyrs, prophets and apostles of learning as there are of religion. To the claims of duty, to the responsibilities of station, to the voices of enlightened conscience such men respond, and they throw their hearts into their work with as much devotion, and as little selfishness, as it is possible for human nature to exhibit. By their labors, knowledge has been accumulated, intellectual capital has been acquired. In these processes of investigation the leading universities of the world are engaged.

This is what laboratories, museums and libraries signify. Nothing is foreign to their purpose, and those who work in them are animated by the firm belief that the advancement of knowledge in any direction contributes to the welfare of man. Nor is research restricted to material things,—the scholars of a university are equally interested in all that pertains to the nature of man, the growth of society, the study of language, and the establishment of the principles of intellectual and moral conduct.

2. Universities are conservative. They encourage the study of the history, the philosophy, the poetry, the drama, the politics, the religion, in fine, the experience of antecedent ages. Successors of the ancient monasteries, they keep alive in our day the knowledge of ancient languages and art, enrich the literature of our mother tongue, hold up to us the highest standards of excellence in writing and enable us to share in the thoughts of the noblest of our race. Let me especially remind you that to the universities men turn instinctively for light on the interpretation of the Scriptures. When new manuscripts are discovered, or new versions are proposed, or new monuments are unearthed, it is to the universities, where the knowledge of ancient and remote tongues has been cherished, that the religious world looks for enlightenment and guidance. Their dominant influence is highly spiritualizing; I would even go farther and say that it is truly religious. I am not unmindful that within the academic circles men are found whose spiritual insight is but dim,—so it is in all other circles,—but I assert without fear of contradiction, that the influence of study is, on the whole, favorable to the growth of spiritual life, to the development of uprightness, unselfishness and faith, or, in other words, it is opposed to epicureanism and materialism. In belief, there are tides as there are in the ocean, ebb and flow, ebb and flow; but the great ocean is there, with its deep mysteries, unchanging amid all superficial changes. Faith, with all its fluctuations, is as permanently operative in human thought as Knowledge.

3. Universities are refining. They are constantly, by laborious processes, by intricate systems of coöperation, and by ingenious methods, engaged in eliminating human errors and in submitting all inherited possessions to those processes which remove the dross and perpetuate the gold. No truth which has once been discovered is allowed to perish,—but the incrustations which cover it are removed. It is the universities which edit, interpret, translate and reiterate the acquisitions of former generations both of literature and science. Their revelation of error is sometimes welcomed but it is generally opposed; nevertheless the process goes on, indifferent alike to plaudits or reproaches. If their lessons are hard to the beginners, they lead the persevering to high enjoyment.

4. Universities distribute knowledge. The scholar does but half his duty who simply acquires knowledge. He must share his possessions with others. This is done in the first place by the instruction of pupils. Experience has certainly demonstrated that with rare exceptions, those men are most learned who produce most. The process of acquiring seems to be promoted by that of imparting. The investigator who is surrounded by a bright circle of friendly inquisitors and critics, finds his best powers developed by this influence. Next to its visible circle of pupils, the university should impart its acqui-

sitions to the world of scholars. Learned publications are therefore to be encouraged. But beyond these formal and well recognized means of communicating knowledge, universities have innumerable less obvious, but not less useful opportunities of conveying their benefits to the outside world.

These general principles I propose to illustrate by asking you to go with me around the circle of the sciences, that we may observe the part which universities have taken or should take in respect to various departments of knowledge.

Let me begin by saying that a university should discover and teach all that can be known of the Human Body. If you ask me why this is so important, I reply, in order that everyone may be able to lead a healthier, stronger and more rational life than is now possible for the want of more knowledge. Hospitals are essential to alleviate sufferings which have been encountered; physical training is of great value; but still more important to humanity is the laboratory in which are studied the laws of life. A celebrated physiologist declares that "a hundred years of life is what Providence intended for man," and others tell us that most of our minor ailments may easily be avoided, and the number of efficient days may be largely increased. Science has proved that many diseases which used to scourge the civilized world may be prevented, and it has recently brought us within sight of new discoveries which will still further interrupt the progress of pestilence. The discoveries of anaesthetics have marvelously alleviated the sufferings of humanity. The causes and remedies of cerebral excitement and degeneration have never been understood as now, and the possibilities have never been so great for the restoration to their normal activity of the powers which have been alienated. In view of these great results and of these anticipations, it is clearly the duty of a university to study all the forms and functions of life which are manifested in organisms lower than man, all the laws which govern animal and vegetable growth, all that can possibly throw light on human physiology.

Those who are devoted to research of this kind, revealing with their microscopes the structure and the life histories of the minutest organisms, are constantly, and in most unexpected ways, coming upon new illustrations of the plan of creation, which have an important bearing upon the welfare of man. They are the interpreters of nature and the benefactors of humanity; and I do not hesitate to add that if there is any branch of learning which at the present time deserves the most generous support, it is surely Biology, because of its obvious relations to the health and happiness of every human being. I cannot but think that those who oppose its study will be ranked in future years among the obscurantists of the nineteenth century.

Next, I mention as the subject for university study, Psychology, the nature of man's soul, the characteristics of his mental and moral activity. This science has lately made great progress,—it has improved its methods and enlarged its scope. Those who are devoted to it appreciate the inherited experiences of the human race and are not indifferent to the lessons which may proceed from intuition and introspection; they study all the manifestations of intellectual and spiritual life; but, on the other hand, they are not afraid to enquire, and they know how to enquire into the physical conditions under which the mind works; they watch the spontaneous, unconventional actions of children; they investigate the laws of heredity; they examine with curious gaze the eccentricities of genius, and with discerning, often with remedial eye, the alienation of human powers, and they believe that by a combination of these and other methods of research, among which experiment has its legitimate place, the conduct of the human understanding and the laws of progressive morality will be better understood, so that more wholesome methods of education will be employed in schools of every grade. They acknowledge the superiority of the soul to the body, and they stand in awe before the mysteries which are as impenetrable to modern investigators as they were to Leibnitz and Spinoza, to Abelard and Aquinas, to Aristotle and Plato, the mysteries of man's conscious responsibility, his intimations of immortality, his relations to the Infinite.

I do not know whether philosophy is on a "return to Kant," or to common sense, but I believe that standing firm on the postulates, God, Soul and Immortality, it will in years to come disentangle many perplexities, brush away heaps of verbal accumulations, and lead the mind to purer and nobler conceptions of righteousness and duty. I go even farther and, as I believe that one truth is never in conflict with another truth, so I believe that the ethics of the New Testament will be accepted by the scientific as well as the religious faculties of man; to the former, as Law; to the latter, as Gospel.

In confirmation of these views, let me quote to you the language of that one among us who is best qualified to speak upon this subject.

"The new psychology, which brings simply a new method and a new standpoint to philosophy, is, I believe, Christian to its root and centre; and its final mission in the world is not merely to trace petty harmonies and small adjustments between science and religion, but to flood and transfuse the new and vaster conceptions of the universe and of man's place in it—now slowly taking form and giving to reason a new cosmos and involving momentous and far reaching practical and social consequences—with the old scriptural sense of unity, rationality and love beneath and above all, with all its wide consequences. The Bible is being slowly re-revealed as man's great text-book in psychology, dealing with him as a whole, his body, mind and will, in all the larger relations to nature and society, which has been so misappreciated simply because it is so deeply divine. That something may be done here to aid this development," continues the lecturer, "is my strongest hope and belief."

The study of Society engages the earnest interest of another set of men, and the apparatus of their laboratory includes archæological and historical memorials of the activity of the race. The domain of history and political science has never been cultivated as it is in modern times. The discovery of primeval monuments and the interpretation of long hidden inscriptions, the publication of ancient documents once hid in monasteries and governmental archives, the inquiry into primitive forms of social organization, the development of improved modes of research, the scientific collection and classification of facts which illustrate the condition of ancient and modern communities and especially the interest awakened in the growth of institutions and constitutions, give to this oldest of studies the freshest interest. Papers which have lately been printed on rudimentary society among boys, on the laws of the mining camp, on the foundations of a socialist community, on the differences between parliamentary and congressional government, on the derivation of modern customs from the ancient beginnings of the Aryan people, on the nature of communism and many more such themes afford illustrations of the mode in which the historical student among us, following the lines of Stubbs, Maine, Freeman, Bluntschli, Roscher, and other celebrated workers, are advancing historical science, and developing the true historical spirit. The aim of all these inquiries is to help on the progress of modern society by showing how the fetters which now bind us were forged, by what patient filing they must be severed, and at the same time to work out the ideal of a society in which Liberty is everywhere, but "Liberty sustained by Law."

Languages and Literature have always been promoted by universities, and will always be dominant for reasons which are as enduring as language itself. We study tongues that we may know the men of other climes and other days; we study literature to enjoy it. As an aid to intercourse with people of other nations and for the purpose of keeping up with the record of modern science, nobody doubts that the modern languages are to be encouraged; but if we really would own the inheritance which is our birthright, if we wish to appreciate the master-pieces of literature, if it is well to put ourselves in sympathy with mankind, to laugh with those who have laughed, and weep with those who have wept, we must not be restricted to the writings of to day. In science, it has been said, read the newest and latest; not so in literature,—but the best. Isaiah and John, Homer and Æschylus, Cicero and Virgil, the Nibelungen Lied and Chaucer, Dante and Petrarch, are as full of life, beauty, instruction and entertainment to us as to former generations. But from the classical standard of excellence this busy world would soon depart, were it not that in every university there are scholars keeping bright the altar fires, and warming us with the glow of their enthusiasm, whenever we come under their influence,—sharpening too our wits by their critical acumen.

It is not uncommon, now-a-days, to hear objections to classical education, usually from those who have never had it, and declamations against dead languages, usually from those who have never learned them. But the Humanists may unquestionably leave it to the Geologists to fight the battle for antiquity. They have shown us that the older the fossils the more instructive their lessons; indeed so much importance is attached to ancient animal life that the national government, with great liberality, encourages its study by promoting explorations, museums, and costly publications. Be it so; but let not the nation which does this, forget that men are of "more value than many sparrows;" that the oldest literature is not old or dead, but fresh and living in comparison with the bones of the cave dwellers; and that though a megatherium is wonderfully instructive, an ancient Epic or a Drama is not unworthy of attention.

Jebb, in his life of Bentley, asserts that probably "the study of classical antiquity, in the largest sense, has never been more really vigorous than it is at the present day." We might add that classical poetry has never been so popular—else why these innumerable editions and translations? Why, after Worsley, Butcher, Bryant and their predecessors, are we reading aloud and smiling over the immortal Odyssey as it is given to us in the rhythmical prose of Palmer? This is a good sign; only it is well to remember that reading translations is not reading Greek, and, as Jebb goes on to say, we must not forget the difference between "the knowledge at second-hand," which the intelligent public can possess, and "the knowledge at first hand" which it is the business of the libraries and professorships of a university to perpetuate.

If the defenders of classical study would confine their argument to the line which was lately followed by Butcher, they would silence their opponents. "To Greece," he says, "we owe the love of science, the love of art, the love of freedom—not science alone, art alone, or freedom alone, but these vitally correlated with one another and brought into organic union. . . . The Greek genius is the European genius in its first and brightest bloom. From a vivifying contact with the Greek spirit, Europe derived that new and mighty impulse which we call progress."

But I must not pass from the subject without a word upon the study of language in general, that faculty of the human race which was never half understood until the universities of Germany entered upon the study of comparative philology, by the introduction of Sanscrit study. With this new torch they have thrown a flood of light upon the nature of speech, the history of our race, the brotherhood of nations and the development of ideas which lie at the basis of all Indo-European civilization.

The Shemitic tongues have long been subjects of university study, especially Hebrew and Arabic —the former so much esteemed as the language of the Old Testament that it used to be spoken of as the language of Paradise, and the latter being regarded as a key to the ideas and religion, the ancient literature and science, of one of the largest families of men. Of late years the domain of Shemitic study has been widened; libraries long hidden have been exhumed on the sites of ancient Babylon and Nineveh; records, the very existence of which was unknown at the beginning of this century, written in characters to which there was then but the slightest clue, are now read and printed and studied as a part of the history of mankind. Assyrian becomes a language of university study—not, indeed, for many scholars, but for a few, and the bearing of their discoveries is so important upon the language and history of the Hebrews that one of the most learned of English theologians has recently said that, in respect to certain of the obscurer passages of the Old Testament, the world must wait for the light which would come from Assyriology.

Certainly, if the history of mankind is worth studying, if the lessons of the past are of value, language and literature, the ancient, the modern, the primitive and the cultivated, will never be neglected among the studies of an enlightened community.

When we turn from Man to his environment, we soon perceive that mathematics lies at the basis of all our knowledge of this world. To count, to measure and to weigh, are steps in civilization, and as we extend our powers in these directions, we find that even the distance and mass of the planets, the form of the earth, the velocity of light, the mechanical equivalent of heat, and the unit of electrical resistance may be accurately ascertained, and the results, with many of the ideas which they involve, may become a part of the intellectual possessions of every educated person. Yet when we reflect that hardly any branch of knowledge is so depreciated by the average man as the modern advancement of pure mathematics, we must believe that its influence upon civilization is not sufficiently considered.

Professsor Cayley, in a recent address, alluded to the connection of mathematics with common life, on the one hand, and with the deepest questions of philosophy, for example the metaphysical ideas of time and space, on the other. As to its utility, he declared that he would defend this science as Socrates defended justice, quite irrespectively of wordly advantages,—and then he proceeds to show the relations of mathematics to the certainty of knowledge, and to emphasize the idea that mathematical science is not built upon experience but upon certain fundamental assumptions,—which are indeed found to be in conformity with experience. I wish that every student, however remote his studies may be from mathematical text-books, would turn to the opening passages of this discourse, and steady his own mental equilibrium by the assurance that the science which is most exact, and most satisfactory in its reasonings, is based upon fundamental postulates which are assumed and not proved by experiment. "In the theory of numbers," he says, "these are very remarkable instances of propositions observed to hold good for very long series of numbers,—and which are nevertheless untrue."

If you persist in taking the utilitarian view and ask me what is the good of Mr. Glaisher's determination of the least factors of the missing three out of the first nine million numbers, the volume containing the sixth million having lately been published;—or if you put a much of more comprehensive question, what is the use the Abelian functions, I shall be forced to say, I do not know; and if you press me harder I shall be obliged to express my conviction that nobody knows; but I know, and you know, and everybody may know, who will take the pains to inquire, that the progress of mathematics underlies and sustains all progress in exact knowledge.

Whewell, the author of the History of Inductive Sciences, has brought out very clearly the fact that "the opening of Greek civilization was marked by the production of geometry, the idea of space was brought to a scientific precision; and likewise the opening of modern European civilization was distinguished by the production of a new science, Mechanics, which soon led to the mechanics of the heavens, and this step, like the former, depended on men arriving at a properly distinct fundamental idea, the idea of force. Henry Smith, arguing for the value of his favorite study to mankind, points out the injury which would come to the intellectual strength of any nation "whose notions of the world and of the things in it, were not braced and girt together with a strong frame work of mathematical reasoning. It is something," he continues, "for men to learn what proof is and what it is not." The work in mathematics at Alexandria or Syracuse two thousand years ago, is as perfect in its kind and as direct and unerring in its appeal to our intelligence, as if it had been done yesterday at Berlin or Göttingen by one of our own contemporaries. In kindred language, Cayley, working forward as well as backward, and not unmindful let us hope, of the Sylvestrian school, upon this side of the Atlantic, in which he had been a master and a guest, thus concluded the address from which I have already quoted.

"Mathematics have steadily advanced from the time of the Greek geometers. Nothing is lost or wasted; the achievements of Euclid, Archimides and Apollonius are as admirable now as they were in their own days. Descartes' method of co-ordinates is a possession forever. But mathematics have never been cultivated more zealously and diligently, or with greater success than in this century—in the last half of it or at the present time; the advances made have been enormous, the actual field is boundless, the future full of hope. In regard to pure mathematics we may most confidently say,

"'Yet I doubt not thro' the ages one increasing purpose runs,
And the thoughts of men are widened with the process of the suns.'"

Many who hesitate to assent to these views of the relation of pure mathematics to civilization, have no question whatever in lauding applied mathematics, especially astronomy and physics; and no wonder, for within the memory of this generation, the world has gained these five results of physical science, steam locomotion, telegraphy, telephony, photography, and electric lighting. The first three, it may be said, have revolutionized the methods of human intercourse; the fourth has multiplied infinitely the means of communicating knowledge to the brain by what Sir William Thomson, following John Bunyan, has termed the Eye-gate; and the fifth, still in its dawn, includes possibilities of illumination, which we are not likely to exaggerate. But I have no time to eulogize these recent gains of civilization; every word I can spare must be given to emphasize the fact which is most likely to be forgotten, that these wonderful inventions are the direct fruit of university studies. I do not undervalue the work of practical men when I say that the most brilliant inventor who ever lived has been dependent upon an unseen company of scholars, the discoverers and the formulators of laws which he has been able to apply to methods and instruments. Nor do I forget that Faraday, like Shakespeare, was not a university man. But I mean to say that the manifold applications of science, about which everybody is talking, are only possible because of the abstract studies which universities promote. The electro-magnetic inventions which are now so multiform are only possible because scores of the greatest intellects of the century, one after another, have applied their powers of absolute reasoning to the interpretation of phenomena, which could have been elucidated in any part of the world, and at any epoch of the past, if only the right methods had been employed. As long as universities held aloof from experimental sciences, these discoveries were not made, but when laboratories for investigation were established, an alliance was formed by mathematics and physics, and a new type of intellectual workers was produced, men whose hands were as cunning to construct and make use of instruments, as their brains were cunning to develop the formulas of mathematics. Take the splendid list of leaders who have followed Franklin and Rumford. They may be called the school of Sir Isaac Newton, so much of their inspiration is due to him. Not all were trained in academic walls; but not one failed to derive help from the advantages which universities provide and perpetuate.

One of the greatest of these men, Sir William Thomson, has lately been here. He was invited to come because it was believed that he, more than any other foreigner, could give an impulse to the study of physics in this country. His lectures were on a subject so remote from ordinary thought that I do not suppose its announcement conveys to those who are unfamiliar with the present position of physical inquiries, the least idea of what the lecturer was to talk about. Nevertheless so great was the attraction of his powers, that a large company, two or three from England, one from Japan, several from beyond the Alleghanies, and many from this neighborhood, most of them teachers and professors of physics, here assembled daily for a month to catch what they could of his learning and his enthusiasm. His words were taken down and have been given to the public in the form of lecture notes, and have thus reached already the principal seats of learning abroad and at home, but the chief results of his visit will be seen as the years go on in the increased devotion of his followers to their science, and in their emulation of his enthusiasm and concentration. Could I give you a more interesting example of the way in which a university may encourage physical science?

Notwithstanding all the progress in physics and astronomy which has been made during a century, those who know the most about these subjects will assure us that they are but at the alphabet of their science. Read the address of the astronomer of Princeton, on a recent occasion, in which he enumerates the impending problems of astronomy; or that of one of our own staff, when he reviews the condition of electrical science and declares that "as the region of the unknown is infinitely greater than the known,—there is no fear of there not being work for the whole world for centuries to come;" and he adds (to please I suppose the practical men) that in the applications of science, "the telephone, the telegraph, and electric lighting, are but as child's play to what the world will see."

Chemistry is the child of the nineteenth century. The atomic theory, which lies at the foundation of all modern investigations, was announced by Dalton,—(that English Friend after whom it would not be amiss to name our chemical laboratory "Dalton Hall," as a tribute alike to his eminence and to the society in which our founder was also trained),—Dalton's law, I say, was announced between 1804 and 1808, so that we can trace more distinctly than in most sciences the exact influences under which Chemistry has grown up. Alchemy, the search for gold or for the philosopher's stone, never became a science, and contributed very little to the good of man; but when the universities of Europe, with their trained observers, their methods of accurate work, their habit of publication, and especially their traditional principles of coöperative study, directed their attention to the fundamental laws of atomic combination, the science of Chemistry grew with rapidity, and with benefits to mankind which can never be enumerated. To no man were its early days more indebted than to Liebig,—"of organic chemistry the very source and fountain head,"—good as a thinker, good as an investigator, good as a lecturer, but better still, as one of his most illustrious pupils has informed us, "in the peripatetic teaching of his laboratory."

"It was at the small University of Giessen," says Hofmann, from whom I have just quoted, that "Liebig organized the first educational laboratory that was ever founded. This school forms an epoch in chemical science. It was here that experimental instruction such as now prevails in our laboratories received its earliest form and fashion, and if we are proud of the magnificent temples raised to experimental science in all our schools and universities, let it never be forgotten that they all owe their origin to the prototype set up by Liebig, half a century ago." The world appreciates the results which have proceeded from these laboratories,—let it also be remembered that they were the creation not of industrial fabrics, not of mercantile corporations, not even of private enterprise, but of universities, and that the motive which inspired their founders and directors was not the acquisition of wealth, but the ascertainment of fundamental law.

The science which began with the century is going forward more rapidly than ever. Yet, if we examine a recent exposition of the principles of theoretical chemistry, we may discover that here, as in mathematics and in physics, the most expert perceive that the field which is open to investigation is much vaster than that which has been surveyed. Here, as everywhere else, the higher one ascends the greater his horizon. What good is to come to men from these researches it would not be wise to predict; but we may reflect on what has recently occurred. Within the last few months a boon has been conferred on humanity so great that all the cost of all the laboratories of all the lands in Christendom would have been a small price to pay for so precious a pearl. It came into the world never again to leave it, unheralded, unexpected, from the laboratory of science, to deaden for a few moments and then restore to life the organs of the sight, so that operations on the eye, hitherto dreaded, may be performed without the slightest pain. The chemists may modestly say that this discovery was an accident not to be compared in significance with the discovery of Avogadro's law. That may be so, yet this sort of accident does not happen in Africa or the Fiji Islands—it "happens" where there are universities and laboratories, and trained men able and ready to observe, discover and apply.

The hour has passed, and I have hardly introduced a theme which would be more appropriate to a volume than to a discourse. I have not spoken of the study of the structure of the earth, the physics of the globe, the laws of storms, the constituent rocks and minerals of this earth, the record of life hidden in ancient strata, the living kingdoms of animals and plants, the distribution of the races of men, the progress of archæology,—or of innumerable sub-divisions in the great branches of human knowledge. Such a task would be beyond my powers; I have only attempted to suggest what each one of you may study for the rest of your lives, as you watch the growth of universities and the progress of knowledge. I have purposely left for another occasion all questions pertaining to professional and technical education.

A few miles east of one of my former homes—the settlement of Berkeley, in California—there is an isolated peak of moderate height, from the top of which you may survey an area equal to that of the State of New York. From Mount Shasta on

Supplementary Classes:

Section I: Brandt's Grammar, Deutsch's Reader: Mr. Hempl. Three times weekly, Monday, Tuesday, and Thursday, 4 p. m. (8).

Emerson, W. H.
Fields.
Lowry.
Mount.
Perkins, C. A.
Taylor, W. D.
Wightman.
Van Vleck.

Section II: Ludwig, Schloss Heimburg: Mr. Hempl. Five times fortnightly, Tuesday, Thursday and alternate Fridays, 3 p. m. (23).

Carter.
Dashiell.
Dorsey.
Ensey.
Ferguson.
Ferris.
Gross.
Hahn.
Hodges.
Hughes.
Jones, W. A.
Lamb.
Lowndes.
Meriwether.
O'Donovan.
Ota.
Preston.
Reeves.
Rouse.
Rowland.
Shemwell.
Straus.
White, J.

Romance Languages. (49 Students).

Classes meet in 111 and 117 W. Monument St.

Advanced Courses: (*Old French Seminary; Romance Languages in Europe; Langue d'oïl Dialects; Comparative Phonology of the Romance Languages, Wallachian*): Mr. Elliott. (5 classes). Monday, 10 a. m. to 12 m.; Tuesday, 12 m.; Wednesday, 9 a. m. to 12 m. (4).

Bowen.
Fontaine.
Perkins, C. A.
Todd.

Advanced Courses: (*Catalan: Portuguese: Old Provençal*): Dr. Todd. (3 classes). Wednesday, Thursday, and Friday, 1 p. m. (4).

Bevan.
Bugg.
Learned.
Perkins, C. A.

Italian: (*Manzoni, Dante*): Dr. Todd. Three times weekly, Monday, 1 p. m., Tuesday and Wednesday, 9 a. m. (6).

Bevan.
Bugg.
Egge.
Fossum.
Howard.
Matzke.

Spanish: (*Knapp's Spanish Readings*): Dr. Todd. Twice weekly, Thursday and Friday, 9 a. m. (4).

Bevan.
Bugg.
Claxton.
Matzke.

French: Major Course: (*Aucassin et Nicolête; French Phonology*): Mr. Elliott. Monday, 12 m., Tuesday, 1 p. m. (7).

Bevan.
Bugg.
Learned.
Matzke.
Perkins, C. A.
Reeves.
Veneziani.

French: Major Course: (*Chanson de Roland*): Dr. Todd. Tuesday and Friday, 10 a. m. (4).

Bugg.
Learned.
Matzke.
Perkins, C. A.

French: Minor Course: Dr. Todd (*Beaumarchais*), Tuesday and Wednesday, 12 m.;—Mr. Bowen (*Memoirs,* XVII *Cent.; Milne-Edwards*), Thursday and Friday, 12 m.;—Mr. Fontaine (*Composition*), Monday, 12 m. (8).

Ames.
Beckwith.
Buckler.
English.
Lowndes.
Pleasants, R. H.
Reeves.
Winslow.

French Conversation: Mr. Fontaine. Four times weekly, Monday, Thursday, Friday, 3 p. m., and Saturday, 9 a. m. (19).

Ames.
Barcroft.
Beckwith.
Birney.
Bugg.
Dreyer.
English.
Fifield.
Guggenheimer.
Hartogensis.
Howard.
Hubbard.
Learned.
Lowndes.
Matzke.
Reeves.
Ryttenberg.
Steiner.
Winslow.

Supplementary Class: Mr. Bowen. Five times fortnightly, Monday, Wednesday, and Friday, 3 p. m. (19).

Bayard.
Brack.
Dorsey.
Doub.
Eareckson.
Ensey.
Ferguson.
Hobbs.
Hodges.
Hughes.
Lamb.
Mount.
Preston.
Rowland.
Stevens.
Straus.
Taylor, W. D.
Tuska.
Young.

The advanced students of the Romance Languages meet as an association fortnightly, Monday, 8 p. m. (9).

Bevan,
Bowen.
Bugg.
Fontaine.
Learned.
Matzke.
Perkins, C. A.
Reeves.
Veneziani.

English and Anglo-Saxon. (66 Students).

Classes meet in 111 and 117 W. Monument St.

Anglo-Saxon: *Béowulf:* Dr. Wood. Weekly, Wednesday, 9 a. m. (9).

Burton.
Cobb.
Dunlap.
Gates.
Hempl.
Learned.
Lerch.
Matzke.
Naeseth.

English Literature of the Fourteenth Century: *Chaucer, Langland, Wyclif, etc:* (*Minor Course*): Dr. Browne. Twice weekly, Tuesday and Friday, 11 a. m. (9).

Applegarth, A. C.
Brackett, J. R.
Burton.
Cobb.
Hughes.
Marks.
Noyes.
Reeves.
Wood, J.

Anglo-Saxon: (*Sweet's Reader: Elene, ed. Zupitza*): Mr. Wright. Twice weekly, Tuesday and Friday, 4 p. m. (6).

Claxton.
Fossum.
Hubbard.
Learned.
Matzke.
Naeseth.

Early English: Mr. Egge. Twice weekly, Tuesday, 9 a. m., and Friday, 12 m. (6).

Burton.
Claxton.
Dunlap.
Gates.
Hubbard.
Naeseth.

English Literature: (*P. H. E. Course*): Continuation of the synoptical view of English Literature: Dr. Browne. Twice weekly, Wednesday and Thursday, 12 m. (49).

Applegarth, E. C.
Birney.
Brack.
Bromwell.
Brune.
Carter.
Coates.
Cole, W. R.
Crosby.
Dashiell.
Dorsey.
Dreyer.
Duffy.
Eareckson.
Ferguson.
Fifield.
Flexner.
Friedenwald.
Gilpin.
Gordon, D. H.
Guggenheimer.
Hoffmann.
Jackson.
Jones, W. A.
Kaessmann.
Laessig.
Loane.
McLane, R. M.
McPherson.
Marks.
O'Donovan.
Preston.
Reese.
Roberts, B. T.
Rogers.
Rouse.
Rowland.
Schaefer, J.
Shemwell.
Stow.
Straus.
Thompson.
Trower.
Tuska.
Weech.
White, E. L.
White, J.
Williams, J. W.
Willis.

History and Political Science. (100 Students).

Classes meet in the rooms of the Bluntschli Library.

Seminary of History and Politics: Dr. Adams. Weekly, Friday, 8 p. m. (24).

Applegarth, A. C.
Berry.
Bonsal.
Brackett, J. R.
Coler.
Dewey.
Fossum.
Gardner, H. B.
Gould.
Holcomb.
Howard.
Levermore.
Lichty.
McMahon.
Morris, C. N.
Newton.
Ota.
Randall.
Sato.
Scaife.
Steiguer.
Wilson, W.
Wood, J.
Worthington.

History of Politics: Dr. Adams. Three times weekly, Monday, Wednesday, and Thursday, 10 a. m. (23).

Applegarth, A. C.
Berry.
Brackett, J. R.
Dewey.
Fossum.
Gardner, H. B.
Holcomb.
Howard.
Levermore.
Lichty.
McMahon.
Miller, E. G.
Morris, C. N.
Newton.
Ota.
Randall.
Sato.
Scaife.
Steiguer.
Wilson, W.
Wood, J.
Woodward.
Worthington.

The Renaissance: Dr. Adams. Twice weekly, Monday and Tuesday, 11 a. m. (18).

Brack.
Color.
Doub.
Egge.
Gardner, H. B.
Lerch.
Lowry.
McMahon.
Newton.
Ota.
Pleasants, J.
Pleasants, R. H.
Price.
Schaefer, J.
Williams, L.
Williams, W. K.
Wood, J.
Woods.

International Law: Dr. Adams. Twice weekly, Monday and Tuesday, 12 m. (6).

Applegarth, A. C.
Claxton.
Howard.
Price.
Ryttenberg.
Steiner.

Finance and Administration: Dr. Ely. Three times weekly, Wednesday, Thursday, and Friday, 12 m. (19).

Applegarth, A. C.
Berry.
Dewey.
Gardner, H. B.
Holcomb.
Howard.
Levermore.
Lichty.
McMahon.
Miller, E. G.
Morris, C. N.
Ota.
Randall.
Sato.
Scaife.
Swift.
Wilson, W.
Wood, J.
Worthington.

History of Political Economy: Dr. Ely. Daily, 1 p. m. (28).

Bayard.
Brune.
Coates.
Doub.
Dunlap.
Ferguson.
Fifield.
Gardner, H. B.
Glenn, J.
Guggenheimer.
Lichty.
Loane.
McMahon.
Meriwether.
Ota.
Pleasants, J.
Pleasants, R. H.
Ryttenberg.
Sams.
Steiguer.
Steiner.
Swift.
Wiesenfeld.
Williams, L.
Williams, W. K.
Wood, J.
Woods.
Young.

English and French History: Dr. Jameson. Three times weekly, Wednesday, Thursday, and Friday, 11 a. m. (11).

Brack.
Doub.
Glenn, J.
Price.
Sams.
Schaefer, J.
Van Vleck.
Williams, L.
Williams, W. K.
Woods.
Young.

American Constitutional History: Dr. Jameson. Three times weekly, Monday, Wednesday, and Thursday, 4 p. m. (15).

Applegarth, A. C.
Claxton.
Dunlap.
Gardner, H. B.
Gates.
Howard.
Lichty.
McMahon.
Meriwether.
Miller, E. G.
Morris, C. N.
Price.
Ryttenberg.
Steiner.
Wood, J.

Roman History: (*P. H. E. Course*): DR. JAMESON. Twice weekly, Monday and Tuesday, 12 m. (44).

Applegarth, E.C.
Birney.
Brack.
Bromwell.
Brune.
Carter.
Cole, W. R.
Crosby.
Dorsey.
Dreyer.
Duffy.
Eareckson.
Ferguson.
Fifield.
Friedenwald.
Gilpin.
Gordon, D. H.
Guggenheimer.
Hoffmann.
Jackson.
Jones, W. A.
Kaessmann.
Laessig.
Lamb.
McLane, R. M.
McPherson.
O'Donovan.
Preston.
Reese.
Roberts, B. T.
Rogers.
Rouse.
Rowland.
Schaefer, J.
Shemwell.
Stow.
Straus.
Thompson.
Trower.
Weech.
White, E. L.
White, J.
Williams, J. W.
Willis.

Relations of Physical Geography to History: (*P. H. E. Course*): DR. JAMESON. Weekly, Friday, 12 m. (51).

Applegarth, E. C.
Armiger.
Birney.
Brack.
Bromwell.
Brune.
Carter.
Coates.
Cole, W. R.
Crosby.
Dashiell.
Dorsey.
Dreyer.
Duffy.
Eareckson.
Ferguson.
Fifield.
Flexner.
Friedenwald.
Gilpin.
Gordon, D. H.
Guggenheimer.
Hoffmann.
Hughes.
Jackson.
Jones, W, A.
Kaessmann.
Laessig.
Lamb.
McLane.
McPherson.
O'Donovan.
Preston.
Reese.
Roberts, B. T.
Rogers.
Rouse.
Rowland.
Schaefer, J.
Shemwell.
Stow.
Straus.
Thompson.
Trower.
Tuska.
Weech.
White, E. L.
White, J.
Williams, J. W.
Willis.
Young.

Psychology and Pedagogics. PROFESSOR HALL. (37 Students).

Psychology. Twice weekly, Monday and Tuesday, 12 m., Biological Laboratory. (21).

Andrews.
Bruce.
Burton.
Campbell.
Colin.
Edmond.
Gross.
Hanna.
Hemmeter.
Jastrow.
Kemp.
Lee.
Lichty.
McClintock.
McCulloch.
Nelson.
Newton.
Noyes.
Scaife.
Steiguer.
Swift.

Educational Course. Weekly, Thursday, 9 a. m., 106 W. Monument Street. (26).

Adler.
Andrews.
Applegarth, A.C.
Berry.
Dewey.
Edmond.
Egge.
Gross.
Holcomb.
Hussey.
Jastrow.
Lee.
Levermore.
McCulloch.
McMahon.
Meriwether.
Morris, C. N.
Nelson.
Newton.
Noyes.
Sato.
Scaife.
Swift.
Wilson, W.
Woodward.
Worthington.

Educational Lectures. On successive Saturdays, at 10 a. m., in Hopkins Hall. This course, by various members of the Academic Staff, is designed for the Fellows and Graduate Students looking forward to scientific and educational careers.

Physical Training. DR. HARTWELL.

All undergraduate students are required to follow the courses of physical training as advised by Dr. Hartwell, the Director of the Gymnasium.

Elocution. (51 Students).

MR. WOODWORTH. Daily, 9 a. m. to 2 p. m.

Applegarth, A.C.
Applegarth, E.C.
Bayard.
Birney.
Coates.
Cole, W. R.
Coler.
Dohme.
Dorsey.
Duffy.
Eareckson.
Eichelberger.
Emerson, W. H.
Ferguson.
Friedenwald.
Gorton.
Guggenheimer.
Hartogensis.
Hobbs.
Horner.
Hough.
Hughes.
Hussey.
Jackson.
Kaessmann.
Laessig.
Lamb.
Lodge.
Lowry.
McCulloch.
McDaniel.
McIntosh.
Reeves
Roberts, D. E.
Rogers.
Ryttenberg.
Schaefer, J.
Slack.
Smith.
Steiguer.
Stein.
Steiner.
Straus.
Trower.
Tuska.
Veneziani.
Wiesenfield.
Willis.
Wingert.
Winslow.
Woods, J.

Drawing. (46 Students).

MR. NEWELL. Daily (except Wednesday and including Saturday) 1 to 5 p. m.

(*Free-Hand Drawing.*)

Ames.
Andrews.
Applegarth, E.C.
Armiger.
Bell.
Birney.
Campbell.
Coates.
Dashiell.
Doub.
Dreyer.
Eareckson.
Emerson, A.
Ensey.
Fifield.
Gilpin.
Gordon.
Guggenheimer.
Haldeman.
Hartogensis.
Herrick.
Horner.
Jones, W. A.
Lowndes.
Noyes.
O'Donovan.
Price.
Randall.
Reese.
Roberts, B. T.
Shemwell.
Smith.
Stein.
Stow.
Straus.
Thompson.
Trower.
Willis.
Winslow.
Williams, J. W.

(*Beginning Mechanical Drawing.*)

Ames.
English.
Ensey.
Laessig.
Roberts, D. E.

(*Advanced Mechanical Drawing.*)

Eichelberger.
Gorton.
McDaniel.

FELLOWS BY COURTESY, 1884-85.

The persons below named have been designated by the Academic Council as Fellows by Courtesy for the current academic year:

GUSTAV BISSING, A. B., Johns Hopkins University.
JAMES W. BRIGHT, PH. D., Johns Hopkins University.
HENRY H. DONALDSON, A. B., Yale College.
JAMES R. DUGGAN, PH. D., Johns Hopkins University.
LOUIS DUNCAN, U. S. Naval Academy.
ADOLPH GERBER, PH. D., University of Munich.
ELGIN R. L. GOULD, A. B., Victoria University.
ARTHUR S. HATHAWAY, B. S., Cornell University.
H. CARVILL LEWIS, A. M., University of Pennsylvania.
ROBERT W. PRENTISS, B. S., Rutgers College.
SHOSUKI SATO, B. S., Sapporo Agricultural College, Japan.
GEORGE M. STERNBERG, Surgeon, U. S. A., M. D., College of Phys. & Surg. (N. Y.).
MORRISON I. SWIFT, A. B., Williams College.
ALEXANDER M. WILCOX, PH. D., Yale College.
LEWIS W. WILHELM, PH. D., Johns Hopkins University.

JOHN C. FIELDS, A. B., University of Toronto, 1884, has been appointed a *Fellow in Mathematics* by the Board of Trustees, on the recommendation of the Academic Council.

ADDITIONS TO THE ROLL OF STUDENTS.

(See pp. 8-11 of *University Circular* No. 34).

GRADUATE STUDENTS.

JOHN W. CALDWELL. A. B., Charleston College, 1861, and A. M., 1868; M. D., Virginia Medical College, 1864. *Chemistry, etc.*	New Orleans, La.	8 *McCulloh St.*
WILLIAM A. HEDRICK. A. M., Columbian University, 1884. *Chemistry.*	Georgetown, D. C.	110 *N. Carey St.*
WILLIAM M. MILROY. A. B., Geneva College (Pa.), 1877; B. D., Yale College, 1882. *Latin.*	Northwood, Ohio.	98 *McCulloh St.*
WILLIAM N. MUMPER. A. B., Dickinson College, 1879. *Physics and Chemistry.*	Dillsburg, Pa.	247 *Linden Av.*
CHRISTEN A. NAESETH. A. B., Norwegian Luther College, 1874, and A. M., 1883. *English.*	Decorah, Iowa.	8 *McCulloh St.*
ROBERT B. RIGGS. A. B., Beloit College, 1876; Ph. D., University of Göttingen, 1883. *Chemistry.*	Oahe, Dakota.	118 *W. Biddle St.*

SPECIAL STUDENTS.

JOHN D. ARMIGER. Charlotte Hall School. *Physics.*	Huntingtown.	47 *Lee St.*
CORNELIUS BRUYN. Rutgers College. *Greek and Latin.*	Kingston, N. Y.	333 *N. Eutaw St.*
F. LOUIS GRAMMER. Lehigh University. *Chemistry.*	Baltimore.	289 *McCulloh St.*
COLYER MERIWETHER. Vanderbilt University. *History and Political Economy.*	Clark's Hill, S. C.	266 *N. Howard*

HOURS FOR LECTURES AND RECITATIONS, SECOND HALF-YEAR, 1884-85.

HOURS.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
A. M. 9	General Chemistry. (Morse.) Carbon Compounds. (Remsen.) Latin Prose. (Spieker.) Animal Morphology. (Brooks.) Old High German. (Wood.) Elocution. (Woodworth.)	General Chemistry. (Morse.) Carbon Compounds. (Remsen.) Horace. (Spieker.) Analyt. Mechanics. (Newcomb.) Italian. (Todd.) Hist. of Anc. Art. (Emerson.) Early English. (Egge.) Elocution. (Woodworth.)	General Chemistry. (Morse.) Carbon Compounds. (Remsen.) Horace. (Spieker.) Italian. (Todd.) Animal Morphology. (Brooks.) Romance Lang.: Adv. (Elliott.) New Test. Greek. (Harris.) Anglo-Saxon: Béowulf. (Wood.) German Conversation. (Gerber.) Elocution. (Woodworth.)	Mineralogy: Elem. (Williams.) Carbon Compounds. (Remsen.) Horace. (Spieker.) Analyt. Mechanics. (Newcomb.) Spanish. (Todd.) Pedagogics. (Hall.) Old High German. (Wood.) German Conversation. (Gerber.) Elocution. (Woodworth.)	Mineralogy: Elem.(Williams.) Carbon Compounds. (Remsen.) Horace. (Spieker.) Spanish. (Todd.) Animal Morphology. (Brooks.) Hist. of Anc. Art. (Emerson.) New Test. Greek. (Harris.) Elocution. (Woodworth.)	Mineralogy: Adv. (Williams.) French Conversation. (Fontaine.)
10	General Physics. (Kimball.) Physiol. and Histol. (Martin.) Electr. and Magnetism. (Rowland.) German: Major. (Hempl.) History of Politics. (Adams.) Latin Prose. (Morris.) Romance Lang.: Adv. (Elliott.) New Test. Greek. (Harris.) Attic Judicial System. (Emerson.) Math.: Intr. for Grad. (Story.) Elocution. (Woodworth.)	General Physics. (Kimball.) Electr. and Magnetism. (Rowland.) German: Major. (Wood.) French: Major. (Todd.) Catullus and Martial. (Morris.) Tacitus. (Warren.) Lyric Poetry. (Gildersleeve.) Sub-Apost. Lit. (Harris.) Math.: Intr. for Grad. (Story.) Elocution. (Woodworth.)	General Physics. (Kimball.) Physiol. and Histol. (Martin.) Electr. and Magnetism. (Rowland). German: Major. (Wood.) History of Politics. (Adams.) Catullus and Martial. (Morris.) Latin at sight. (Warren.) Romance Lang.: Adv. (Elliott.) New Test. Greek. (Harris.) General Zoology. (Brooks.) Hebrew Exercises. (Haupt.) Math.: Intr. for Grad. (Story.) Elocution. (Woodworth.)	General Physics. (Kimball.) Electr. and Magnetism. (Rowland.) German: Major. (Hempl.) History of Politics. (Adams.) Catullus and Martial. (Morris.) Tacitus. (Warren.) Sanskrit: Adv. (Bloomfield.) Sub-Apost. Lit. (Harris.) Cuneiform Texts. (Haupt.) Math.: Intr. for Grad. (Story.) Elocution. (Woodworth.)	General Physics. (Kimball.) Physiol. and Histol. (Martin.) Electr. and Magnetism. (Rowland.) German: Major. (Wood.) French: Major. (Todd.) Catullus and Martial. (Morris.) Tacitus. (Warren.) Greek Syntax. (Gildersleeve.) New Test. Greek. (Harris.) General Zoology. (Brooks.) Math.: Intr. for Grad. (Story.) Elocution. (Woodworth).	Educational Lectures. Mineralogy: Adv. (Williams.)
11	General Biology. (Martin.) German: Minor. (Hempl.) Renaissance. (Adams.) Greek Prose. (Spieker.) Sanskrit: Elem. (Bloomfield.) Romance Lang.: Adv. (Elliott.) Linear Diff. Equations. (Craig.) Solid Anal. Geom. (Franklin.) Elocution. (Woodworth.)	General Biology. (Martin.) German: Minor. (Wood.) Renaissance. (Adams.) Latin Seminary. (Warren.) Homer. (Spieker.) Differential Equations. (Craig.) English: Minor. (Browne.) Elocution. (Woodworth.)	Osteology. (McMurrich.) German: Minor. (Hempl.) English & French Hist. (Jameson.) Homer. (Spieker.) Aramaean. (Haupt.) Romance Lang: Adv. (Elliott.) Linear Diff. Equations. (Craig.) Solid Anal. Geom. (Franklin.) Elocution. (Woodworth.)	General Biology. (Martin.) German: Minor. (Hempl.) English & French Hist. (Jameson.) Latin Exercises. (Warren.) Homer. (Spieker.) Sumero-Akkadian. (Haupt.) Differential Equations. (Craig.) Sub-Apost. Lit. (Harris.) Elocution. (Woodworth.)	Osteology. (McMurrich.) German: Minor. (Wood.) English & French Hist. (Jameson.) Latin Seminary. (Warren.) Homer. (Spieker.) Linear Diff. Equations. (Craig.) Solid Anal. Geom. (Franklin.) English: Minor. (Browne.) Elocution. (Woodworth.)	Vedic Sanskrit. (Bloomfield.) Mineralogy: Adv. (Williams.)
M. 12	Greek Seminary. (Gildersleeve.) Psychology. (Hall.) French: Minor. (Fontaine.) Greek Prose. (Morris.) Quaternions. (Story.) International Law. (Adams.) French: Major. (Elliott.) History: P. H. E. (Jameson.) Elocution. (Woodworth.)	Greek Grammar. (Gildersleeve.) Psychology. (Hall.) French: Minor. (Todd.) Modern Algebra. (Story.) International Law. (Adams.) Romance Lang: Adv. (Elliott.) History: P. H. E. (Jameson.) German Conversation. (Gerber.) Problems in Mechanics. (12.30). (Franklin.) Elocution. (Woodworth.)	Greek Seminary. (Gildersleeve.) French: Minor. (Todd.) Aeschylus and Eurip. (Morris.) Quaternions. (Story.) Polit. Econ.: Adv. (Ely.) Mineralogy: Adv. (Williams.) English Lit.: P. H. E. (Browne.) Comp. Gram. of German. (Wood.) Elocution. (Woodworth.)	Greek Oratory. (Gildersleeve.) French: Minor. (Bowen.) Aeschylus and Eurip. (Morris.) Modern Algebra. (Story.) Polit. Econ.: Adv. (Ely.) Mineralogy: Adv. (Williams.) English Lit.: P. H. E. (Browne.) Middle High German. (Wood.) Problems in Mechanics (12.30). (Franklin.) Elocution. (Woodworth.)	French: Minor. (Bowen.) Aeschylus and Eurip. (Morris.) Quaternions. (Story.) Polit. Econ.: Adv. (Ely.) Sanskrit: Elem. (Bloomfield.) Mineralogy: Adv. (Williams.) Phys. Geog.: P. H. E. (Jameson.) German Conversation. (Gerber.) Early English. Egge. Elocution. (Woodworth.)	
P. M. 1	Polit. Econ.: Elem. (Ely.) Italian. (Todd.) Theory of Functions. (Craig.) Calculus. (Franklin.) German Conversation. (Gerber.) Drawing. (Newell.) Elocution. (Woodworth.)	Polit. Econ.: Elem. (Ely.) French: Major. (Elliott.) Conic Sections. (Story.) Drawing. (Newell.) Elocution. (Woodworth.)	Polit. Econ.: Elem. (Ely.) Romance Lang: Adv. (Todd.) Theory of Functions. (Craig.) Calculus. (Franklin.) Elocution. (Woodworth.)	Polit. Econ.: Elem. (Ely.) Romance Lang: Adv. (Todd.) Conic Sections. (Story.) Drawing. (Newell.) Elocution. (Woodworth.)	Polit. Econ.: Elem. (Ely.) Romance Lang.: Adv. (Todd.) Theory of Functions. (Craig.) Calculus. (Franklin.) Drawing. (Newell.) Elocution. (Woodworth.)	Drawing. (Newell.)
2	Drawing. (Newell.) Latin. (Slaughter.)	Drawing. (Newell.)	Latin. (Slaughter.)	Drawing. (Newell.)	Drawing. (Newell.) Latin. (Slaughter.)	Drawing. (Newell.)
3	French Conversation. (Fontaine.) German: Minor. (Hempl.) French: Elem. (Bowen.) Classical Archaeol. (Emerson.) Drawing. (Newell.)	Hebrew: Elem. (Haupt.) German: Elem. (Hempl.) Drawing. (Newell.)	Arabic. (Haupt.) German: Minor. (Hempl.) French: Elem. Bowen.)	Assyrian. (Haupt.) French Conversation. (Fontaine.) German: Elem. (Hempl.) Drawing. (Newell.)	French Conversation. (Fontaine.) German: Elem. (Hempl.) (Alternate Fridays.) French: Elem. (Bowen.) (Alternate Fridays.) Drawing. (Newell.)	Drawing. (Newell.)
4	Comp. Gram. of Greek. (Bloomfield.) German Style. (Wood). (Monthly.) Analytic Geometry. (Franklin.) German: Elem. (Hempl.) Am. Const. Hist. (Jameson.) Drawing. (Newell.) Romance Lang. Society. (8 p. m. fortnightly.) Math. Sem. (Newcomb.) (8 p. m.)	Physics: Major. (Kimball.) Psalms. (Haupt.) Anglo-Saxon. (Wright.) German: Elem. (Hempl.) (Alternate Tuesdays.) Drawing. (Newell.)	Ethiopic. (Haupt.) Comp. Philol. (Bloomfield.) Analytic Geometry. (Franklin.) Am. Const. Hist. (Jameson.)	Physics: Major. (Kimball.) Ethiopic. (Haupt.) German: Elem. (Hempl.) Am. Const. Hist. (Jameson.) Drawing. (Newell.) Math. Sem. (Story.) (8 p. m.)	Math. Seminary. (Craig.) Anglo-Saxon. (Wright.) Analytic Geometry. (Franklin.) Drawing. (Newell.) Hist. Sem. (Adams.) (8 p. m.)	Drawing. (Newell.)

The public lectures begin at 5 p. m.

. Six Letters to P. Burmann. Berlin, 1860. D.
De verb. comp. Plautina. Warsaw, 1876. O.
a Philologica Classica. Berlin, 1880. O.
e Halieuticis. Berlin, 1878. O.
. Obs in Horatii Sat. I. De itinere Brundisino. Lanfelan, 1880. D.
. Krit. anmerk z. Lysias. Jever, 1881. Q.
r, M. Das rhythmische Gesetz des Demosthenes. Königsburg, 1880. Q.
De locis aliquot Juvenalis. Bonn, 1849. O.
De Vocabulorum ap. Tacitum collocatione. Berlin, 1874. Q.
G. De ling. Lat. adject. suffixo—to. Düsseldorff. 1873. D.
, R. Lucretianae Quaestiones. Halis, 1861. D.
Intersitne aliquid int. Horatii Satiras et Epistolas. Czernowitz, 1874. D.
B. De praepositionum ap. Sophoclem usu. I. Grimma, 1878. Q.
ck, E. Platonis Phaedri dispositio. Berlin, 1805. D.
Obs. Gram. et Crit. ad usum. partic. Plautinum. Berlin, 1881. O.
A. De Elocutione A. Cornelii Celsi. Upsal, 1872. D.
De Canone decem Oratorum Atticorum. Vratislaviae, 1883. O.
E. Homerische Realien. Bd. 2, Abth. 1-2. Leipzig, 1881 and 83. O.
V. Commentatis q. Cicero Orat. p. Archia Autores n. e. demonstr. Schwerin,
:.

O. De interrog. ἢ et οὐκουν part. ap. tragicos usu. Vratislaviae, 1865. D.
, F. Anthologiae Epigraphicae latinae spec. Gryphiswaldia, 1870. Q.
r, C. T. Observationes Persianae. Schwerin, 1878. Q.
. F. De Vita Dionysii Hal. n. p , n. d. Q.
De dupl. recensionis orat. De Falsa Legatione. Berlin, 1880. D.

. Dativi localis vis atque usus in Homeri carminibus. Hannover, 1864. D.
De Comparationibus Vergilianis. Haguenau, 1883. Q.
Ueber die urform einiger Rhapsodien der Ilias. Berlin, 1850. D.
3. J. De futuro Herodoteo. Lund. n. d. Q.
. Ueb. d. sogenante Epithet. ornam. i. d. Horazischen Oden. Brünn, 1878. D.
. Notae Graecorum. Florence, 1749. F.
ines du VIe Siécle. Ed. Champollion-Figeac. Paris, 1837. F.
Fastorum Horatianorum Epicrisis. Monachii, 1877. Q.
Finibus. Ed. J. S. Reid. Vol. III. Cambridge, 1883. O.
atio pro Sestio. Ed. H. A. Holden. London, 1883. D.
eizel, R) Untersuch. z. Cicero's Philos. Schriften III. Leipzig, 1883. O.
us. Carmina. Rec. E. Ludwig. Lipsiae, 1877. D.
. Origines Poesis Romanae. Berlin, 1846. O.
De M. Porcii Catonis vita, &c. Savone, 1882. Q.
Quaest. de Vitis a Script. Historiae Augustae conser. Vratislavia, 1883. D.
De Manilii qui dicitur Elocutione. Argentorati, 1882. D.
. Idées morales de l'éloquence politique de Démosthène. Montpellier, 1874.

. Les Plaidoyers politiques de Démosthène. 2 v. Paris, 1879. D.
A. Horaz u. seine Zeit. Berlin, 1883. D.
es. Against Androtion and Timocrates, Ed. Wayte. Cambridge, 1882. D.
Ausgewählte reden. Erk. J. Sörgel. Gotha, 1883. D.
Neun Philipp. redn. Erk. v. Rehdantz. 6 aufl. Leipzig, 1881. D.
Oration agt. the law of Leptines. Ed. Beatson. Cambridge, 1880. D.
Orations agt. Meidias. Trans. by A. M. Fennell. Cambridge, n. d. D.
Orationes publicae. Philippics. Ed. S. H. Heslop. London, n. d. D.
Philippics. Ed. F. B. Tarbell. Boston, 1880. D.
J. C. Xenophontis liber de Vectigalibus. diss. Trajecti s/R, 1851. O.
De Isaei vita et scriptis. Halis, 1831. Q.
F. Die Theologie des Aristoteles. Leipzig, 1883. O.
ger, W. Horatiana. Aachen, 1841. Q.
Satura Grammatica. Lipsiae, 1872. Q.
De dativi ap. Horatium usu. Landskron, 1878. D.
. Vindiciae Juvenalianae. Münster, 1870. D.
Beiträge z. Erkl. v. Demosth. Red. p. d. Megalopoliten. Ehringer, 1882. Q.
. D. Glossarium Med. et Inf. Latinitatis. Editio nova. Niort, 1883. Q.
r, E. De Particularum usu ap. Catullum, etc. Halis, 1881. D.
A. Beiträge z. Horaz. u. Vergil. Gnesen, 1877. Q
. Orationes privat. causarum Demostheniae. Berlin, 1877. Q.

. De Casuum usu Horatiano. Wernigerode, 1866. Q.
De Imperativi usu Horatiano. Wernigerode, 1870. Q.
De Anacoluthorum usu in Scriptis Graecorum. Dillenburg, 1860. Q.
De Floro elocutionis Taciteae imitatore. Münster, 1882. O.
. De Tibulli elocutione. Halis, 1880. D.
Quaestiones Lycurgeae. Halis, 1870. D.
C. De Satira Lucilii. n. p. 1851. Q.
De dum partic. usu Plautino. Halis, 1882. D.
ntus (L. Müller). Eine Einleitung i. d. stud. d. röm. poesie. St. Petersburg,
).
Graecorum. Fragmenten I. Coll. G. Kinkel. Lipsiae, 1877. D.
Prosopographia Juvenalis. Amsterdam, 1864. O.
). De Apulei elocutione. Stendae, 1861. Q.
M. Pseudolysiae oratio funebris. Lipsiae, 1881. O.
gusta. Violarium. Rec. J. Flach. Lipsiae, 1880. D.
Ausgewählte Tragödien. Erk. v. Wecklein. Iphigenis i. T. Leipzig, 1876. D.
Hippolytus. Erk. v. T. Barthold. Berlin, 1880. D.
m Palatinum. Ed. C. Tischendorf. Lipsiae, 1847. F.

M. De ὡς, ὥστε partic . . ap. tragicos Graec. Breslau, 1883. D.
. R. Gebrauch d. indicativus futuri . . bei Homer. Breslau, 1865. Q.
Quaestiones Dinarcheae. Greifswald, 1883. D.

Fischer, E. De Vocibus Lucianis. Halis Sax, 1881. D.
Fischer, E W. Griechische Zeittafeln. n. p. n. d. Q.
Fischer, H. Ueb. Einige v. d. Seewesen entlehnte ausdrücke, etc. Meiningen, 1870. Q.
Fischer, W. De locis quibus dam Propertianis. Bonn, 1863. D.
Flach, H. Das Dialektische Digamma des Hesiodos. Berlin, 1876. O.
Forshhammer, P. W. Die Athener und Socrates. Berlin, 1837. D.
Francke, W. De Andocidis Oratione de Pace. Halis Sax, 1876. O.
Franzius, J. Elementa Epigraphices Graecae. Berlin, 1840. Q.
Frenzel, W. De Andocidis de Pace Oratione. Regimonti, 1866. O.
Friedlander, L. De temporibus librorum Martialis, etc. Regimonti, 1862. Q.
De temporibus librorum Martialis, X. et XI. Regimonti, 1865. Q.
De personis a Martiali commemoratis. Regimonti, 1878. Q.
De Locis corruptis in Martialis Epigrammatis. Regimonti, 1867. Q.
Frizell, A. Collatio codicum Livianorum I.-III. Upsal, 1878. D.
Fritzsche, T. Menipp u. Horaz. Güstrow, 1871. O.
De Interpolationibus Horatianis. Güstrow, 1878. Q.
Fürth, A. Quaestiones Lucilianae. Bonn, 1866. D.

Garruccius, R. Sylloge inscriptionum Latinarum. Aug. Taurinorum, 1877. O.
Gebbing, H. De C. Valerii Flacci tropis et figuris. Marburg, 1878. D.
Georges, K. E. Ausfürhrliches lateinish-deutsches Handwörterbuch. 2 vols. Leipzig, 1879. O.
Gericke, J. De Abundanti dicendi genere Tacitino. Berlin, 1882. O.
Gerlach, F. D. Lucilius u. d. römische satura. Basel, 1844. Q.
Gerner, J. M. Linguae et eruditionis Romanae Thesaurus. 2 vols Lipsiae, 1749. F.
Genther, L. Gebrauch des metaphers bei Juvenal. Wittenberg, 1878. Q.
Gilbert, W. Ad Martialem quaestiones criticae. Dresden, 1883. Q.
Goebel, A. Lexilogus z. Homer u. d. Homeriden. 2 v. Berlin, 1878. O.
. Eine Wiener Juvenal handschrift. Wien, 1859. O.
Goerbig, W. Nominum . . . loca significantur usus Plautinus. Halberstadt, 1883. D.
Göttingische Gelehrte Anzeigen. Göttingen, 1883. D.
Grabenstein, A. De interrogationum usu Horatiano. Halis, 1883. O.
Graffunder, P. De Crippsiano et Oxom. Antiphontis Codicibus. Berlin, 1832. O.
Groth, A. De Varronis de Ling. Lat. Codice Florentino. Strassburg, 1880. O.
Grubel, B. De satirae Romanae origine. Posen, 1883. Q.
Gruenwald, E. Quae ratio intercedere videatur inter Quintil. et Tacit. Berlin, 1883. D.
Gruppe, O. F. Minos, ueb. d. Interpolationen i. d. röm. Dichtern. Leipzig, 1859. O.
Gulde, O. Quaest. de Lysiae orat. in Nicomachum. Berlin, 1882. O.
Gumpert, F. Beitr. z. Kritik d. Horaz Sat. I. 1. Buxtehude, 1881. Q.
Günther, F. De Conjunct. causal. ap. Quintilianum usu. Halis, 1881. D.
Guttmann, C. De Caesarian. orat. Tulliam. genere dicendo. Greifswald, 1883. D.

Haeckermann, A. Der Pithöanische Codex Juvenals. I. Greifswald, 1856. Q.
Haeckermann, A. Comment. in Juvenalis Satiras. Greifswald, 1867. Q.
Haeckermann, A. Zur kritik u. erklärung Juvenals. Greifswald, 1877. Q.
Haenicke. Kritische untersuchung üb. d. 12 Satire d. Juvenal. Pultbus, 1877. Q.
Hahn. De Articuli apud tragicos Graecos . . usu. Salzwedel, 1846. Q.
Halfpap, R. Quaestiones Servianae. Gryphiswaldiae, 1882. D.
Hansen, M. De tropis et figuris ap. Tibullum. Kiel, 1881. D.
Hardt, W. De Aeschinis Emendatione. Halis, 1882. D.
Harnecker, O. Qua necessit. conjunctus fuerit c. Cicerone Catullus. Friedeburg, 1882. Q.
Harnecker, O. Catulls Carmen 68. Friedeburg, 1881. Q.
Hasper, T. Ad Epidicum Plautinam coniectanea. Dresdae, 1882. Q.
Hasper, T. De Poenuli Plaut. dupl. Exitu. Lipsiae, 1868. D.
Haupt, M. De Aetna carmine. Berlin, 1860. Q.
Haupt, M. De Euripidis Hercule Furente. Berlin, 1864. Q.
Haustein, A. De Genetivi adjectivis accomodati . . . usu. Halis, 1882. D.
Hebold, M. De infinitivi Syntaxi Euripidea. Halis, 1881. D.
Heckmanns, A. Persiana. Münster, 1875. D.
Heidtmann. Garantie f. d. echtheit d. Caesars De Bell. Civ. Essen, 1867. Q.
Heinrich, C. F. Schedae Lycurgeae. Bonn, 1850. Q.
Held. Rede. des Demosth. Περὶ Παραπρεσβείας. Lemgo, 1881. Q.
Heller, H. Die Absichtsätze bri Lucian. N. p., n. d. D.
Hennen, G. De Hannonis in Poenulo precatione. Marburg, 1882. D.
Hensell, F. W. De praepositionis "per" usu Taciteo Marburg, 1876. D.
Hermann, C. F. Vindiciae Juvenaliae. Gottingae, 1854. Q.
Hermann, C. F. De Codicibus Juvenalis recte Existimandis. Gottingae, 1847. Q.
Hermann, K. F. Z. Rechtfertigung . . . d. Briefwechs. Cicero u. Brutus. Göttingen, 1845. Q.
Hermes. Berlin, 1883. O.
Herodotus. Books 1 and 2 with Eng. Notes by H. G. Woods. 2 vols. London, 1878. D.
Historiae. Rec. H. Stein. 2 vols. Berlin, 1869. O.
Herzog, E. Gesch. u. system d. römischen Staatsverfassung. Leipzig, 1884. O.
Heusde, J. A. C. van. Horatii Sat. I., IX. N. p., n. d. D.
Heusde, J. A. C. van. Studia critica in C. Lucilium. Trajecti, 1842. O.
Heymann, P. In Propertium Quaest. gram. et orthograph. Halis, 1883. D.
Heynemann, S. De interpolation. i. Carm. Horatii. Bonn, 1871. Q.
Hieronymus. De Viris inlustribus. Rec. W. Herding. Lipsiae, 1879. D.
Hildebrand, G. F. Sprachgebrauch d. Livius. Dortmund, 1865. Q.
Hirt, O. Commentationes Lysiacae. Berlin, 1881. O.
Hitzig, H. Studien zu Isaeus. Bern, 1883. Q.
Hoeck, A. De Demosthenis adversus Pantaenetum Oratione. Berlin, 1878. O.
Hoehne, A. De Infin. ap. Graecos poetas usu, &c. Breslau, 1867. D.
Hoffmann, E. Studien a d. gebiete der Lateinischen Syntax. Wien, 1884. O.
Hoffmann, G. De Taciti annalibus historiisque. Berlin, 1878. D.
Hofmann, M. J. Zur kritik u. Erkl. einiger Satiren d. Juvenal. Arnberg, 1878. D.

REPORTS OF RECENT COMMUNICATIONS TO THE UNIVERSITY SOCIETIES; AND OTHER SCIENTIFIC NOTES.

Observations on the Temperature Sense. By HENRY HERBERT DONALDSON.

[Abstract of a paper read at a meeting of the University Scientific Association, March 11, 1885].

In the course of an investigation undertaken with Professor G. Stanley Hall, and under his direction, it was incidentally observed that the sensation of cold on the skin was felt only at definite spots.

The fact arrested our attention and some maps of the distribution of these spots on various parts of the body were made.

When the experiments had reached this point, a paper by Magnus Blix of Upsala, (Experimentelle Beiträge zur Lösung der Frage über die Specifische Energie der Hautnerven. *Zeitschr. f. Biol.*, B. XX, Hf. 2, s. 141, 1884) came into our hands. This author finds definite spots on the skin at which sensations of cold only are aroused, others, distinct from the first, and equally definite, for the sensation of heat, while between these two sets of spots he can arouse sensations of pressure only.

These reactions he obtains both by electrical and thermal stimulation of the skin. He points out that his observations bring the skin nerves under the law of the specific energy of nerves, and also that they render superfluous the various explanations for our sensations of heat and cold which have been suggested, while supposing them due to a single nervous apparatus.

Nature (Jan. 15, 1885, Vol. 31, No. 794) gives the abstract of a paper by Prof. Eulenberg before the Physiological Society at Berlin on December 12, 1884, in which Prof. Eulenberg states that he has been able to verify the observations of Blix. He also mentions that a Dr. Goldscheider of Neisse had independently reached the same conclusion as Blix. So far as known nothing further has appeared on this subject.

My first endeavor was to make some accurate maps of the cold and hot spots. Blix had already published some maps but they were based on a free-hand localization of the spots and it seemed worth while to repeat the experiments with apparatus which would give results certainly accurate. The maps thus obtained are practically the same as those of Blix. The method will be described in a future paper.

In accordance with the observers mentioned it was found that the distribution of spots on corresponding parts differed in different individuals; that the distribution on symmetrical parts of the body was different; that the number of cold spots was greater than the number of hot spots; that the relative abundance of the two kinds varied in different parts of the skin and that, roughly speaking, there are two grades of both kinds of spots, *i. e.*, those which react almost always—which constitute the first grade, and those which react less than half the time and from which the sensation is comparatively faint—which form the second grade.

I find that the spots are very small—as a rule less than a millimeter in diameter; that they are easily exhausted; that the sensation roused by a single stimulus often lasts, however, for some minutes after the removal of the stimulus. For this work I have used thermal stimuli entirely.

Experiments have, however, been carefully made with electrical and mechanical stimulations. In neither case are the results satisfactory, so that for the present I cannot confirm any results obtained by others on this point.

As a spot thermally sensitive was found to move about as the skin moved, the natural idea that the spots were in the skin and not below, was confirmed.

To determine whether any definite histological peculiarity could be made out for these spots—two, one hot and one cold were cut from my skin and examined. The sections prepared by the gold chloride method showed no structures with which the sensations could be associated. As the papillae contained no special end-organ, scars from burns and other causes were examined to determine whether these spots could be found where the papillae were absent.

Spots both for cold and heat were found on the scars and they were as sensitive as those in the sound skin.

Just what this result means is not at present clear, because so little is known of the distribution of nerves in scars.

In a recent article, Pollitzer (*Journ. of Physiol.*, Vol. V, No. 3, p. 143) described a new method of investigating the relative temperature and sensibility of different parts of the body by means of radiant heat, thus doing away with contact and the sensations of pressure. Using his method, the hot spots were found to respond from eight to forty times more quickly to a given stimulus than the not-hot ones.

The explanation of any sensation of heat on the not-hot spot appears to be that there is conduction of heat through the skin, so that the stimulus finally reaches a hot spot.

The general bearing of these observations of the discrete nature of our temperature sensations, which were independently made in Upsala, Neisse, and Baltimore, is considerable, for not only do they throw out the speculations on the manner in which one set of nerves could mediate the sensations of heat and cold, but a vast amount of work done on the skin and having special reference to the psycho-physic law must now be reviewed in the light of the fact that the sensations of heat and cold are derived only from distinct and definite spots on the surface of the body.

On a probable Equivalent in Sanskrit of the Greek Particle ἄρ, ῥὰ. By M. BLOOMFIELD.

[Abstract of a paper read at a meeting of the University Philological Association, February 6, 1885].

From the Rig-Veda down to the classical period of the language there are found a few adverbs of time formed by adding the suffix *-rhi* to certain pronominal stems: *kárhi, tárhi, etárhi, yárhi, amúrhi.* These seem to be made with the suffix *-rhi* much in the same way as other temporal adverbs, *e. g.*, with suffix *-dā: kadā*, etc., and accordingly the grammars (*e. g.*, Whitney, § 1103 c.) project a suffix *-rhi*, which is certainly very remarkable, when considered in the light of the remaining formative material of the language. It is believed that this *-rhi* consists of the two particles *ṛ* + *hi* = Greek ἀρ + γε, which are added to homophonous instrumentals of the several pronouns; cf. Vedic *amā́, anā́, sánā*, etc.

The Greek particles ἀρα, ἀρ and ῥὰ express progress or advance after an action which has preceded, and from which it (the progress) naturally springs. So, *e. g.*, Il., 2, 16: ὣς φάτο . βῆ δ'ἀρ' ὀνειρος, ἐπεὶ τὸν μῦθον ἀκουσεν. Zeus had said: βάσκ' ἴθι οὖλε ὀνειρε; the dream hears the word of Zeus: *then* and *therefore* he comes. It is easily seen that a prominent practical exhibition of the particle is likely to take place in connection with two consecutive statements, which involve time. This is very frequently the case in Greek. But precisely this is the scope of the Sanskrit adverbs, as may be seen from the following parallel passages. Il., 24, 788–9:

ἦμος δ'ἠριγένεια φάνη ῥοδοδάκτυλος ἠώς
τῆμος ἄρ' ἀμφὶ πυρὴν κλυτοῦ Ἕκτορος ἤγρετο λαός.

AV., III, 13, 6: manye bhejāno amṛtasya *tarhi*, hiraṇyavarṇā atṛpam yadā vaḥ: "When I have taken my fill of you, O ye golden colored (waters), *then* I ween that I am enjoying ambrosia."

In Sanskrit, *yárhi*, the relative "when," is correlative with *tárhi*, "then." So in the Aitareya-brāhmaṇa, I, 27: *yarhi* vāva vo mayā' rtho bhavitā *tarhy* eva vo punar āgantāsmi: "*When* you shall have any use for me, *then* shall I again come to you." If these correlative adverbs do really contain an equivalent of ἀρ, we must assign a double value to the particle in temporal sentences. Not only does it appear in the principal clause of two temporal clauses in hypotactic construction, indicating that the principal clause springs naturally from the subordinate clause, but the particle has also the power of indicating proleptically in the subordinate clause, that the principal one will spring from it. Now precisely that seems to be the value of the particle, *e. g.*, in the passages Od., 11, 1–2, and Il., 24, 32–3:

αὐτὰρ ἐπεί ῥ' ἐπὶ νῆα κατήλθομεν ἠδὲ θάλασσαν
νῆα μεν ἀρ πάμπρωτον ἐρύσσαμεν εἰς ἅλα δῖαν.

ἄλλ' ὅτε δή ῥ' ἐκ τοῖο δυωδεκάτη γένετ' ἠώς
καὶ τότ' ἄρ' ἀθανάτοισι μετηύδα φοῖβος 'Απόλλων.

The use of *hi* = γε in addition to *ṛ* = ἄρ is probably only one more exhibition of the fondness which the older forms of Sanskrit exhibit for aggregation of particles as, *e. g.*, Çatapathabrāhmaṇa, II, 2, 2, 20: *tad u ha api* aruṇam āupaveçim jñātaya ūcuh: "*Now* the kinsmen spake to Aruṇa Aupaveçi" (Eggeling's translation). Here the four words *tad u ha api* are rendered by a careful translator by the single word "*now.*" The restriction of the particle *ṛ* from a general use to a special use in temporal clauses, and there, moreover, only in connection with those particular adverbs of time, represents no new principle. It is the same as is exhibited in the restriction of, *e. g.*, ἐπι, to adverbial and prepositional use in Greek, while in Sanskrit *ápi* is both adverb, preposition, emphatic particle, interrogative word, and even interjection.

On the "pistic nard" of Mark, xiv, 3, and John, xii, 3.

By J. Rendel Harris.

Great perplexity has been caused by this word to Scripture interpreters, from early times down to the present day, as may be seen by a glance at the authorized version which adopts the "spikenard" of the Vulgate, accompanied by two marginal alternatives, "pure nard" or "liquid nard," or the revised version which, while retaining the earlier rendering of the text intact, has the following extensive note: "Gr. *pistic nard*, pistic being, perhaps, a local name; others take it to mean *genuine*; others *liquid*."

Here, then, are four different renderings; the first of which regards πιστική as a transmutation of the Latin *spicata;* the second is a suggestion of S. Augustine, in Tractatus L. in Joannem, (Migne. Patr. Lat. 35, 1760); quod sit *pistici* locum aliquem credere debemus unde hoc erat unguentum pretiosum; the third interpretation has the greatest weight of patristic authority, and in deriving the word from πιστός we are supported by the fact that Dioscorides and Pliny describe the methods by which the pure nard was adulterated. Last of all there was the conjecture that the word was connected in some way with πίνω, and means either potable or liquid.

It seems to me that the second of these suggestions is the correct one, and that a very simple conjectural restoration will clear the whole matter up. Suppose we write out the passage in Mark, in half hexameters we have

αλαΒαCΤΡΟΝΜΥΡΟΥΝαΡ
ΔΟΥΠΙCΤΙΚΗC

A glance at this will suggest that the confusion arises from the letters CT in the first line. If these have replaced by a common accident a letter in the next line all can be explained; for let this letter be Δ, and remark the continual confusion between letters formed by the same vertical strokes (ΠΙ = ΙΝ) with fine cross-strokes, and we may read

αλαΒαCΤΡΟΝΜΥΡΟΥΝαΡ
ΔΟΥΙΝΔΙΚΗC

which is perfectly lucid and explains the πολυτελοῦς which follows.

The question arises whether there was any such variety as Indian nard. To settle this point we refer to Dioscorides, De Mat. Med., Α. 6, where we find as follows:

Περὶ Νάρδου. *Νάρδου ἐστὶ δύο γένη. ἡ μὲν γάρ τις καλεῖται 'Ινδικὴ ἡ δὲ Συριακή. οὐχ ὅτι ἐν Συρίᾳ εὑρίσκεται ἀλλ' ὅτι τοῦ ὄρους ἐν ᾧ γεννᾶται τὸ μὲν πρὸς Συρίαν τέτραπται τὸ δὲ πρὸς 'Ινδούς. καὶ τῆς λεγομένης Συριακῆς εστι βελτίων ἡ πρόσφατος κούφη καὶ πολύκομος, ξανθὴ τὴν χρόαν, εὐώδης ἄγαν καὶ μετὰ τοῦ κυπειρίζειν ἐν τῇ ὀσμῇ, πυκνὸν ἔχουσα τὸν στάχυν, πικρὰ τὴν γεῦσιν καὶ γλώσσης ἀναξηραντικὴ ἐπιμένουσά τε τῇ εὐωδίᾳ ἐφ' ἱκανόν. Τῆς δὲ 'Ινδικῆς ἡ μέν τις λέγεται Γαγγῖτις ἀπό τινος ποταμοῦ παραρρέοντος τοῦ ὄρους, Γάγγου καλουμένου παρ' ᾧ φύεται κτέ.*

Whether we agree with all the geographical statements of Dioscorides or not, it is clear that the leading variety of nard in the eastern market bore the title 'Ινδική.

And the same statements will be found confirmed in Pliny, Nat. Hist., xii, 26, who describes carefully the Indian nard, condemns the variety brought from the neighborhood of the Ganges as worthless, and gives the market value of the commodity at 100 denarii the pound, which is one-third of the price mentioned in the Gospels. "De folio nardi (sc. Indici) plura dici par est, ut principali in unguentis . . . alterum ejus genus apud Gangem nascens. . . . In nostro orbe proxime laudatur Syriacum mox Gallicum, tertio loco Creticum . . . sunt autem ea omnia herbæ præter Indicum, &c."

It is curious that the error in the early texts of Mark has not only affected all copies of this Gospel but by inheritance or assimilation is found also in the Gospel of John.

The preceding correction has been nearly approached by other writers who supposed that the text as attested both by Mark and John must be correct, and sought for an Indian *city* of name approximating to the text. Thus Bengel notes, (Gnomon in loc.). "*Pista* urbs Indorum, in regione Cabul; qua ex regione pleraque aromata jam tum petebantur. Vid. Lud. de Dieu in Act., p. 133. Sed ex nomine proprio potius formaretur Πισταῖος." This, however near the truth, assumes too extensive an acquaintance with the geography of the remote parts of the earth.

By way of conclusion we may remark that the words of Dioscorides: *ἐπιμένουσά τε τῇ εὐωδίᾳ ἐφ' ἱκανόν* form a suggestive postil to the incident recorded in the Scripture, *ὅπου ἐὰν κηρυχθῇ τὸ εὐαγγέλιον εἰς ὅλον τὸν κόσμον, καὶ ὃ ἐποίησεν αὕτη λαληθήσεται εἰς μνημόσυνον αὐτῆς.*

On some Oracles in Herodotus, V. 92.

By W. M. Arnolt.

[Abstract of a paper read at a meeting of the University Philological Association, February 6, 1885].

All that we know of the oracle of Zeus at Dodona, shows that the Mantic art was originally nothing but an instinctive meteorology. In order to learn the changes of weather, one had to examine the sky, or to speak mythologically, one had to consult Zeus, the *τερπικέραυνος, νεφεληγερέτα, αἰγίοχος*, who had the storm in his power. The great reputation of the oracle reaches far back into the earliest history of Greece, to the time when the harvest was a question of vital importance to every tribe.

The regular succession of the products of the field according to the order of the seasons was a temptation to attribute to the field the same power as to the sky. Thus, in the Theogonia we find that the oracular divinities are the earth and the starry sky, cp. also Aesch., Eum., l. 1 and 2. The reputation which the oracle of Zeus at Dodona enjoyed in the heroic time, passed over in the following period to the oracles of Apollo and especially that at Delphi.

The agricultural tribes had become political bodies. As long as they had no further interests at stake than their harvest, they consulted Zeus, *i. e.*, the atmosphere. It was a kind of science which they exercised. But when they wanted to know about success in war, the founding of cities, etc., they asked the god to enlighten their minds. Science became inspiration. The oracle revealed the future very reluctantly. It mostly gave advice. It was consulted before every enterprise, political or religious, social or private. With the end of the political freedom of Greece, the important and predominant position of the oracle ceased. Only minor forms of divination, referring to private interests, survived. For example, I refer to Carapanos *Dodone et ses ruines*, I, Paris, 1878, where, *e. g.*, a person named 'Αγις consulted the oracle to find out who had stolen his mattress and pillow, (pg. 75), No. 10, cf. also, (pg. 75), No. 11:

'Ερωτῇ Λυσα-
νίας Δία Νάϊον
καὶ Δηώναν ἦ οὐ
κ ἔστι ἐξ αὐτοῦ
τὸ παιδάριον
ὃ ἂν Νύλα κυεῖ.

or No. 15, where one asks:

ἦ αὐτὸς πεπαμένος τὰν ἐπόλι οἰκίαν καὶ τὸ χωρί–
ον βέλτιόμ μοι κ'εἴη καὶ πολὺ ὠφελετέον.

The period of mysticism had begun and prophetic caves became in vogue, most famous of all being the cave of Trophonius at Lebadia in Bœotia.

The oracles mentioned 1) in the Lydian λόγοι, Her., I. 1–94,
2) in the Libyan λόγοι, Her., IV. 145–205,
3) in the history of Kypselos of Corinth, V. 92,

belong to one and the same class and have many points in common, *e. g.*,

a) the tendency to glorify and exalt the oracle,
b) the three dynasties sprang from a comparatively humble origin,
c) the pre-appointed and pre-determined duration of their government.

The whole story of Kypselos, as it is related by Herodotus, has grown out of a play upon the word *Κύψελος*. The same holds true with regard to the oracle of Battus.

The second oracle in Herodotus' account (chronologically the first) predicts to the Corinthians the might and fierceness of Kypselos long before his birth.

The first oracle in Herodotus (chronologically the second) is still given before his birth. The Bacchiadae receive notice that Labda is about to give birth to one who would prove their ruin. The dangerous infant escapes destruction only by a hair's breadth, being preserved from the intent of his destroyer by lucky concealment in a chest (*κυψέλη*).

The third oracle, evidently, was not composed before the fall of the dynasty. The real source from which the story of the persecution rose, must have been the cruelty of Kypselos, as represented by Sosicles. That Kypselos, however, was by no means a cruel tyrant, may be seen from Arist.; Pol., V. 12 (p. 1315, *b*. Berl.): *Κύψελος μὲν γὰρ δημαγωγὸς ἦν καὶ κατὰ τὴν ἀρχὴν διετέλεσεν ἀδορυφόρητος.*

When Herodotus says, that in remembrance of the danger from which the child had escaped, it was named Kypselos, after the corn-bin (*κυψέλη*) in which it was concealed, we may safely turn the statement around and say from the name Kypselos and the circumstances of his life, the whole story of his escape and the accompanying oracles were composed.

It is true that Pausanias saw, in the temple at Olympia, a corn-bin (*Κυψελιδῶν ἀνάθημα*) said to have been the same wherein Kypselos was hidden. It was of cedar, beautifully carved and inlaid with gold and ivory. Perhaps the story grew up, in part, out of this offering. Cf. O. Jahn. Archäol. Aufsätze, 1844, pp. 1–16; L. Preller, Ausgew. Aufsätze, pp. 425–433; J. Overbeck, Abhandlg. der Phil.-Hist. Classe d. Kgl. Sächs. Ges. d. W., 1865, p. 589 ff.

The name Kypselos was very common in the family of the father of Kypselos. His father was of the house of Kaeneus, and one of the Athenian branch of this family bore the name Kypselos (Herod., VI. 34; Aelian, Varia Hist., XII. 45).

The phraseology of the oracles in Herodotus is mostly taken from Homer, Hesiod, and the Homeric hymns; the most evident example being that of VI. 86. In the oracles, Her., V. 92, we notice:

1). *πολύτιτος* = *πολύτιμος*, formed after the Homeric *ἄτιτος* of Il., XIV. 484.
    on *κύω* and *κυέω* (*κυῶ*), cf. Lobeck, Soph., Ajax (2), pp. 131–3.
    τέξω for the usual *τέξομαι* occurs in Od., II. 249, h. hom. Merc., 493.
    ὀλοοίτροχος, Il., XIII. 137, of Buttmann, Lexilogus^2, II., p. 234, No. 102.
2). *ὠμηστής* reminds us of Il., XI. 454, *οἰωνοὶ ὠμησταί*. Cf. Curtius, Studien, v. 105.
    πολλῶν δ' ὑπὸ γούνατα λύσει is a Homeric formula, cf. Il., IV. 176, etc.
    εὖ φράζεσθε, cf. Od., I, 269, etc. *ὀφρυόεσσα Ἴλιος*, Il., XXII. 411.
3). *ἐσκαταβαίνω* c. acc. cf. Od., XXIV. 222. [Dio Chrys.], Or., 37, p. 103 R., *εἰσαφικάνει*, which is to be preferred.
    κλειτοῖο Κορίνθου, some read *κλεινοῖο*, but this does not occur in Homer, II. 294 Dind.
    ὁ Κόρινθος occurs Herod., V. 92; Strabo, VIII. 378, (who evidently took his account of Kypselos from Herod., and 380, where he cites an oracle: *εὐδαίμων ὁ Κόρινθος, ἐγὼ δ' εἴην Τεγεάτης*), Plut., Prov. A., c. 4.

I think that the metre accounts for the use of the masculine gender.

Λάβδα, according to the Etym. Magnum, 199, 25 (ad voc. *βλαισός*) is the same as *λάμβδα*.

βλαισός· ὁ τοὺς πόδας ἐπὶ τὸ ἔξω διεστραμμένος καὶ τῷ Λ στοιχείῳ εἰκώς. διὰ τοῦτο καὶ Λάμβδα ἐκαλεῖτο ἡ γυνὴ μὲν Ἠετίωνος μητὴρ δὲ Κυψέλου τοῦ Κορινθίου τυράννου.

Rawlinson says Labda is a nickname given to indicate lameness. It would be more correct to say, that from the name Labda originated the story of her lameness, inasmuch as according to Pott (Kuhn's Zeitschr., VII, 321), Curt. Etym^5, 655, *Λάβδα* is equal to *Λαΐς*. An inscription cited by Richard Schöne in the *Annali dell' Instit.*, 1870, p. 339, gives the form ΛΑϜΙΣ. This would point to the root *λαϜ* = *λαβ*. Thus, *Λάβ-δα* = from *ΛαϜι-α* = *popularis, vulgaris.*

On the Western Text of the New Testament. By J. Rendel Harris.

[Abstract of a paper read at a meeting of the University Philological Association, March 2, 1885].

The object of this paper was: (1) to show that allowance had not been made in critical editions of the New Testament for lateral textual aberrations; (2) to point out that in the analysis of conflate readings to which so much importance has been attached by Westcott and Hort the correct reading does not always lie with the so-called Neutral text, but is sometimes found in the Western readings; and (3) to intimate that the Western readings generally deserve more than the occasional respect and subsidiary position which have been accorded them by the latest editors.

The paper will appear in the next number of the *American Journal of Philology.*

On the Dialects of North Germany. By E. H. Spieker.

[Abstract of a paper read before the University Philological Association, January 9, 1885].

The present predominance of High German over Low German did not always exist. For centuries before Luther's time there was no feeling of superiority attaching to the dialects of South Germany. Old and middle Low German produced literary monuments that need not be ashamed to stand by the side of those of High German of the same periods. Heliand and Reineke Vos (the latter of which though not originally Low German, gave to Germany the Low German name for this beast epic,) are evidences of the literary activity of the people of the Northern country. Then for about two centuries there follows a dreary void. During this time Low German sinks to the position of a dialect of the people, no longer the bearer of a literature. In the present century, however, the effort has been made to restore the old condition of affairs by Claus Groth and Fritz Reuter, both recognized, even by the most envious critics, as men of undoubted genius, especially the latter, who, among his many other productions, gave to Germany in his humorous work, "Olle Camellen," a kind of literature it never possessed before. A society has been formed to keep these dialects in their purity and to prevent the encroachments of High German, but with questionable success.

As there has been no literature for so long a time, there is now no acknowledged literary dialect as in South Germany. Of the many different forms of Low German, Fritz Reuter used the Mecklenburg and Claus Groth the Ditmarsch dialect. In the second half of the paper, differences between these dialects and others, especially forms met with in Hanover, were considered (1) in inflection, (2) in vocabulary, and (3) phonetically.

These dialects will probably never be able to become independent of or compete with High German, but they will always be worthy of study in that they have been used by a Fritz Reuter and a Claus Groth.

On the Extension of Rolle's Theorem to Non-uniform Functions. By C. Veneziani.

[Abstract of a paper read at a meeting of the University Mathematical Society, March 17, 1885].

I consider the function $\phi(x) = \frac{A_1}{x - a_1} + \frac{A_2}{x - a_2} + \ldots \frac{A_n}{x - a_n}$, (the summation extending to $n = \infty$) where $A_1, A_2, \ldots$ are imaginary or real quantities and $\sum_{i=1}^{i=\infty}$ mod. A_i is a convergent series; $a_1, a_2, \ldots$ are the affixes of points inside or on a convex contour C, so that for any small area inside that contour we have in our series an infinity of points; then (see for more details *Poincaré, Acta Societatis Fennicæ*, tom. XII, p. 343) $\varphi(x)$ will be developable in ascending powers of $(x - b)$, b being the affix of the centre of a circle externally tangential to the contour C and x being inside that circle.

This may be easily proved in the following way:

Σ mod. A being convergent, ΣA will be also convergent, and $\Sigma \frac{A}{x - a}$ for x exterior to C will be convergent; each term of $\Sigma \frac{A}{x - a}$ is developable according to ascending powers of $(x - b)$, the double series so formed is convergent, therefore (see *Briot et Bouquet*, p. 108) we may arrange it vertically and so we obtain $\phi(x)$ developed according to increasing powers of $(x - b)$.

As $\phi(x)$ is not susceptible of a development in any region so small as one may please inside the contour C, the function $\phi(x)$ is said to admit C and the region of the plane comprised in it as a lacunary space.

Let us now consider $\phi(x)$ when the A's are all positive quantities, in that case $\phi(x)$ can never vanish except for $x = \infty$, because

$$\sum_{i=1}^{i=\infty} \frac{A_i}{x - a_i} = \sum_{i=1}^{i=\infty} \frac{A_i}{\rho_i} \cos\theta_i - \sqrt{-1} \sum_{i=1}^{i=\infty} \frac{A_i}{\rho_i} \sin\theta_i,$$

ρ_i and θ_i, being respectively the modulus and argument of $(x - a_i)$, or supposing the point a_i endowed with the mass A_i attracting the point x endowed with the unit of mass, inversely proportional to its distance, and directly proportional to its mass, the component would be $-\frac{A_i}{\rho_i}\cos\theta_i$ and $-\frac{A_i}{\rho_i}\sin\theta_i$, the components of the resultant attraction of all the points situated inside or on the contour C, will be $-\Sigma\frac{A}{\rho}\cos\theta$ and $-\Sigma\frac{A}{\rho}\sin\theta$; but it is evident that the resultant attraction cannot vanish because x is external to the contour C, consequently $\Sigma\frac{A}{\rho}\cos\theta$ and $\Sigma\frac{A}{\rho}\sin\theta$ will not vanish simultaneously and therefore $\phi(x)$ cannot vanish.

If we take only a finite number of points situated in a convex polygon whose vertices are included among these points, the remaining points being inside, then we see that $\frac{A_1}{x - a_1} + \frac{A_2}{x - a_2} + \ldots \frac{A_m}{x - a_m} = \phi(x)$ is a uniform function which will have as many zeros as infinities, consequently m zeros, $m - 1$ situated inside of the polygon and one at infinity.

The function $\phi(x)$ is the logarithmic derivative of the function

$$\Phi(x) = (x - a_1)^{A_1}(x - a_2)^{A_2}(x - a_m)^{A_m},$$

the A's are all positive quantities but they can be integer as well as fractional or irrational quantities, in the first case Φ and $\frac{d\Phi}{dx}$ are uniform functions, in the second they admit a finite number of values for any value of x, in the third an infinity.

The logarithmic derivative of $\Phi(x)$ is in every one of the three cases a uniform function, its value being $\phi(x)$. Calling $a_1, a_2, \ldots a_{m-1}$ the roots interior to the polygon, we shall have

$$\Phi'(x) = (A_1 + A_2 + \ldots A_m)(x - a_1)(x - a_2)$$
$$\ldots(x - a^{m-1})(x - a_1)^{A_1 - 1}(x - a_2)^{A_2 - 1} \ldots (x - a^m)^{A_m - 1},$$

and consequently the following theorem:

The derivative of $(x - a_1)^{A}(x - a_2)^{A_2} \ldots (x - a_m)^{A_m}$, where the A's are all positive quantities, rational or irrational, admits inside of the polygon $m - 1$ roots, besides those roots of Φ, which it also admits in consequence of the A's, which are greater than unity.

As long as the A's are positive, the process can be applied to the successive derivatives and the roots will be comprised in the same polygon; but as soon as one or more of the A's becomes negative, one or more of the roots of the derivative can be outside the polygon.

As my object was only to show that the extension of Rolle's theorem by Cesaro (see *Giornale di Battaglini*, July and August, 1882) is applicable in some cases to non-uniform functions, I shall not enter into further discussion of the subject.

Ideal Division of Algebraic Quantities by Real Primes. By ARTHUR S. HATHAWAY.

[Abstract of a paper read at the meeting of the University Mathematical Society, April 15, 1885.]

It is well known that by using algebraic quantities in general, any prime can be resolved into factors in an infinite number of ways. For instance ± 5 is the product of the roots of any equation $0 = 5 + a_1x + a_2x^2 + \ldots + x^n$. To meet this fact, the usual theory of Ideal Primes deals only with rational functions of a root of a given irreducible equation. It is practically a definition in that theory that in order that a rational function of a root may be divisible by a real prime, each coefficient of the function must be divisible by the prime. Real primes are then in general no longer primes; but are the products of a certain number of "ideal" prime factors. In the present theory we begin with the assumption that when algebraic quantities in general are introduced, real primes still retain the property of primes with one important modification, viz., they may be separated into parts by means of factors which are roots of the primes and their powers. In other words, we start with an assumption which is broad enough to cover the fact with which we are first met on introducing algebraic quantities. The Units in this theory are quantities which are relatively prime to every real number except unity; and every algebraic quantity is "ideally" resoluble in only one way into products of definite powers of real primes and units. This ideal resolution is equivalent to the following definitions of division by a real prime:

I. As many roots of an equation

$$a_0x^n + a_1x^{n-1} + \ldots a_{n-1}x + a_n = 0 \tag{1}$$

are divisible by *some* positive power of a real prime p, as there are successive coefficients $a_n, a_{n-1}, \ldots$ divisible by p ($a_0, a_1, \ldots a_{n-1}, a_n$ being integers without common divisor). Reciprocally, as many roots are divisible by negative powers of p as there are successive coefficients $a_0, a_1, \ldots$ divisible by p.

The substitution of xp^t for x in an equation is, of course, equivalent to dividing each of the roots of the equation by p^t. Hence:

II. Just as many of the roots of equation (1), $f(x) = 0$, are divisible by the relatively prime factor p^t as there are roots of the equation $f(xp^t) = 0$ which are free from p both in positive and negative powers.

Let us suppose that after the extraneous powers of p are removed from $f(xp^t)$ that the first coefficients which are relatively prime to p, counting from each end of the equation towards the middle, are the coefficients of x^{r+s} and x^r. The coefficients of these powers in $f(x) = 0$, are exactly divisible respectively by p^{s_1}, p^{s_2}, say. Then, after the substitution of xp^t for x, these coefficients contain respectively, $p^{(r+s)t+s_1}$ and p^{rt+s_2}. These must, we have supposed, divide out simultaneously, $\therefore (r + s)\,t + s_1 = rt + s_2$ or $t = \frac{s_2 - s_1}{s}$. Again, for this value of t, $n - (r + s)$ roots of $f(xp^t) = 0$ are divisible by negative powers of p and r roots are divisible by positive powers of p, so that the number of roots free from p is s. Hence the proposition:

If the coefficients of an equation are rational in p (that is, contain p to an entire power as relatively prime factor), then the product of all its roots which contain the same relatively prime factor p^t, is rational in p.

As an example of the application of this proposition we may show that the following general equation (all the quantities concerned being integers) is irreducible, viz.:

$$a_0x^n + p^s(a_1x^{n-1} + \ldots a_{n-1}x +{}^{s} a_n) = 0, \tag{2}$$

where p is a prime not contained in a_0 or a_n, and s is relatively prime to n. For if p is not contained in a_0 or a_n, each root of equation (2) has the relatively prime factor $p^{\frac{s}{n}}$; and if $\frac{s}{n}$ is a fraction in its lowest terms, n such roots must, by the preceding proposition, occur in any equation with integer coefficients. So also, if s and n have the greatest common divisor d, then $\frac{n}{d}$ or a multiple of $\frac{n}{d}$ of the roots of equation (2) are found together in any equation whose coefficients are rational in p.

It is the purpose of the series of papers begun in Vol. VI, No. 4, of the *American Journal of Mathematics* to show the application of this theory of ideal division to the Theory of Numbers.

Note in Regard to the Influence of Magnetism on Chemical Action. By IRA REMSEN.

[Reprinted from the *American Chemical Journal*, 6, 430, February, 1885].

Some time ago (*American Chemical Journal*, 3, 157), I described an experiment which seemed to prove that chemical action is, under some circumstances, influenced by magnetism. I afterwards found that somewhat similar experiments had been performed by Robert Hunt (*Philosophical Magazine*, [3], 28, 1), and that after Hunt, Wartmann (*Ibid.*, [3], 30) had worked on the subject, and had come to the conclusion that magnetism does not influence chemical action. In 1882, at the Fall meeting of the National Academy of Sciences, I gave an account of later experiments by myself, and stated that the work would be continued. In 1883, in Vol. I, No. 2, of *Science*, I published a short paper, in which I called attention to the fact that I was engaged in repeating Hunt's experiments, and I proposed to continue the investigation as long as there seemed promise of obtaining results of value. The work has suffered some interruption since then, but has at no time been given up. The unsatisfactory results reached in repeating Hunt's experiments have interfered with work in new and more profitable directions. Lately I have secured the services of an assistant, and am now pushing the investigation forward as rapidly as the character of the work will permit. We have already obtained some extremely interesting results in depositing various metals upon iron and nickel under the influence of a powerful magnet, and we are now engaged in the study of the action of various acids upon metals. We have found that when iron in a magnetic fluid is treated with nitric acid, certain parts of the iron are protected, while other parts are dissolved with varying degrees of rapidity according to the position with reference to the protected parts. Experiments with hydrochloric acid give similar results, though it appears that the parts protected are not the same as in the case of nitric acid. A full account of the results reached will be published in due time. The object of this notice is merely to call the attention of other workers to the fact that my work on the general subject of "Chemical Action in a Magnetic Field" has not been abandoned, and that through the aid of the Trustees of the Bache Fund it is now in my power to continue it without interruption. I have no desire nor right to prevent others from working in the same field, but I would be glad to communicate with any who may contemplate undertaking such work, as unnecessary duplication may thus be avoided.

RECENT PUBLICATIONS.

Pindar. The Olympian and Pythian Odes. With an Introductory Essay, Notes, and Indexes. By Basil L. Gildersleeve. (New York: Harper & Brothers, 1885, pp. cxv + 395.)

In this edition the Metrical Schemes are presented according to the system of Dr. J. H. H. Schmidt as revised by that scholar, and the rhythmical recitation is facilitated by dots placed under the leading stressed syllables. The Introductory Essay is divided into the following sections: I. Life of Pindar; II. Pindar's Works; III. Pindar's Theme; IV. Pindar's Thought; V. Pindar's Style and Art; VI. Pindar's Development; VII. Metres of Pindar; VIII. Pindar's Dialect; IX. Pindar's Syntax. The Notes occupy nearly 250 pages. In the introduction to the several odes an effort has been made to show how the meaning of the whole reveals itself to him who simply follows the poet's guidance. Critical observations are made only when they seem to be fruitful for the beginner or necessary for the vindication of the text, which has been constituted according to the editor's best judgment. The Indexes—Greek Index (17 pp.) and Index of Subjects (9 pp.)—while they do not undertake to be exhaustive are fuller than one finds in the majority of school editions. The editor is emphatic in the expression of a desire to have the book considered as a mere introduction to Pindar and has designedly limited the range of parallel passages from antique and modern literature. There are some thirty illustrations, nearly all of them being enlarged reproductions from Professor Percy Gardner's Types of Greek Coins.

Photographs of the Bryennios Manuscript. Three pages of the Bryennios Manuscript, reproduced by photography from the original text. Edited by J. Rendel Harris. (Publication Agency of the Johns Hopkins University, April, 1885.)

On the thirty-first of January, 1885, the Reverend Charles R. Hale, D.D., one of the ministers of St. Paul's Church in Baltimore, during his visit to Constantinople, called at the residence of the Patriarch of Jerusalem (to whom he bore official introductions), in order to see if permission could be obtained to make a photographic copy of the manuscript of the "Teaching of the Twelve Apostles." The Patriarch was absent in Jerusalem, but the Archimandrite in charge of the Library allowed photographs of three pages to be taken, leaving it for the Patriarch to decide whether anything more could be hereafter permitted.

These pages include the last verses of the Epistle of Barnabas; the superscription and opening of the first Epistle of Clement; the close of the second Epistle of Clement; the first verses of The Teaching of the Apostles; the last verses of the Epistle of Ignatius to the Romans; etc.

The photographs are believed to be of so much interest to scholars that a limited number of reproductions have been published, with a transcription of the text with palaeographic details by Mr. J. Rendel Harris, Associate Professor of New Testament Greek and of Palaeography in this University, and some notes on the Catalogue of Old Testament writings contained in the MS. by Mr. Cyrus Adler, a graduate student of the Shemitic Languages.

A few copies were offered for sale at one dollar net. The edition was strictly limited to one hundred and twenty-five copies, and all of these have now been subscribed for. There is no doubt that a much larger edition might have been readily disposed of, but it was thought best, in the hope of obtaining before long a complete set of fac-similes of the Teaching of the Apostles, to restrict the present publication. It is believed that these are the first fac-similes that have yet been published from this important MS. The eagerness with which they were sought after is another index of the wide-spread interest in early Patristic literature among American scholars.

Recent American Socialism. By Richard T. Ely. (Studies in Historical and Political Science. Third Series, No. 4, pp. 74, April, 1885.)

Although the present monograph deals chiefly with some of the more recent phases of socialism in the United States, a brief sketch is given in the opening pages of the past history of American socialistic and communistic movements, beginning with the "oldest American charter." The first settlement of the English on American soil at Jamestown, Virginia, was likewise the first step in a long and unbroken line of social experimentation in the New World. The Jamestown communism like that of the New England Puritans seems, however, never to have been anything more than a temporary makeshift, and it left no lasting impression on the country.

But before the Declaration of Independence in 1774, there came to this country a society of men and women with the determination to lead a purely communistic life for all future time. These were the Shakers who open the period of communistic villages of which many still exist in the United States. One of the most noteworthy examples of them is Icaria in Iowa, though probably the wealthiest settlement is that of Economy, near Pittsburg. The "Harmonists" count their wealth by the million. This early American communism is now antiquated, and exists only as a curious and interesting survival.

But about 1870 there began to manifest itself in the United States a different kind of socialism which did not look forward to the peaceful growth of communistic villages, but expected to accomplish its ends by a revolution in economic and political life. This revolutionary socialism still lives and is stronger to-day than it ever has been before.

A most important event in the history of modern socialism in the United States was the publication of Henry George's "Progress and Poverty" in 1879. Henry George has rendered two distinct services to the cause of socialism: first, in the no-rent theory he has furnished a rallying point for all discontented laborers; second, his book has served as a wedge for other still more radical and far-reaching measures.

There are in the United States two parties of socialists which may be called revolutionary, these are known respectively as the "Socialistic Labor Party" and the "International Working People's Association." These parties differ in most important particulars, although they agree upon certain fundamental propositions. Their divergence is first and foremost one of method. The Internationalists are a party of violence, believing in the use of dynamite and like weapons of warfare as a means of attaining their purposes, while the adherents of the Socialistic Labor Party condemn these tactics and have not renounced all hope of a peaceable revolution of society.

In this monograph an attempt is made to describe carefully the characteristics of these two parties, and copious extracts are given from their writings, both as proof and illustration of what is said. An estimate is made of their strength and the dangers to be apprehended from them are indicated. Finally, remedies for existing evils and the path of safe progress are pointed out.

The titles of the various chapters give the best idea of the scope of the present paper: (1), Retrospective—Early American Communism; (2), Henry George and the Beginnings of Revolutionary Socialism in the United States; (3), The International Working People's Association; (4), The Propaganda of Deed and the Educational Campaign; (5), The Socialistic Labor Party; (6), The Strength of Revolutionary Socialism—Its Significance; (7), The Remedies.

Local Institutions of Virginia. By EDWARD INGLE. (Studies in Historical and Political Science. Third Series, Nos. II–III, pp. 127. February–March, 1885.)

This monograph is made up of six essays upon the institutional life of Virginia before the Revolution. As an introduction the social life of Virginians is discussed and a brief description of the colony is given. Considerable space is devoted to the subject of land tenure as underlying all institutions, and it is shown how the system of entail and primogeniture directly influenced the governmental ideas of the first English colony. The curious but short-lived institution of the Hundred is next described and statements are quoted to show that the word was used in Virginia as implying a military division, a place to be settled by a body of persons originally a hundred men or heads of families, a member of an incorporated town, an area for representation and rating, as related indirectly to the county and parish, and as giving a name to sub-societies of the Virginia Company.

Under the title "The English Parish in America" is given the history of the parish system of Virginia, with its churchwardens, sidesmen, vestrymen, workhouses, care of the poor, induction of rectors, and curious modes of procedure versus offenders against morality or ecclesiastical laws. The conclusion is drawn that while the township of New England was the parish of England shorn of its ecclesiastical powers, the parish of Virginia was the English parish stripped of some of its civil functions. The intercourse of vestry and other parish meetings were no doubt efficacious in helping on public opinion against encroachments of England, but the Revolution, resulting from this, put an end to the parish as a political institution.

The Virginia counties were at first the outspreading of towns, which later grew up from the desire of people to have some centre where legal business and trade might be conveniently carried on. As the Assembly of the colony may be considered the counties taken collectively, the house of burgesses is treated of, and in that connection is given a brief summary of the doings of the first English legislative body in America, which met at Jamestown in 1619. The county form of government is best suited to the wants of an agricultural community, and as long as Virginia remains such in the main, the county system will prevail.

The essay on "The Town" is devoted to the legislation for town government, for, with but two exceptions, there were no incorporated towns in the colony. Norfolk is taken as the example for the incorporated town, and in an appendix is printed a copy of the charter granted in 1736. The monograph concludes with some statements as to attempts which have been made to force a township organization upon Virginia, and the causes of their failure. At the end is given a bibliography of materials upon Virginia history.

La Chanson de Roland. Translated from the seventh edition of Léon Gautier, by LÉONCE RABILLON. (New York, Henry Holt & Co., 1885.)

The publication in America of a new English version of the Chanson de Roland is not only an event of interest to students of Romance literature, but may also be regarded as marking a stage of progress in the more general appreciation of mediæval poetry. Since the appearance, a little less than half a century ago, of the *editio princeps* of this earliest and most important epic of French literature, something like a score of translations, including those in Modern French, have been made of it into the leading European languages. The explanation of this popularity may easily be given. Starting from an historical basis, the Song of Roland voiced in true epic strain the passions and impulses of an heroic age, and has left its sturdy impress on the literature of modern Europe.

The present volume is the seventh in the uniform "Library of Foreign Poetry" published by Messrs. Henry Holt & Co. Only two versions in English had preceded the one before us. The first, a mere prose condensation of the poem by Mrs. Marsh, appeared in 1854. The second is a metrical and rhymed translation, with introduction, by John O'Hagan, M. A., from the press of C. Kegan Paul & Co., 1880. The distinguishing feature of the present translation, which is in blank verse, consists in its fidelity, as far as the genius of English permits, to the stirring rhythm of the original. In form it will accordingly be found to reflect more closely than either of its English predecessors, the antique source from which it springs. The text is accompanied by a brief preface indicating historical sources, manuscripts, etc., and by a glossary of proper names and obscure words.

American Journal of Mathematics. SIMON NEWCOMB, Editor; THOMAS CRAIG, Associate Editor.

CONTENTS OF VOL. VII, No. 3. BALTIMORE, APRIL, 1885.

On the Algebra of Logic. By C. S. PEIRCE.

Sur les Equations Linéaires aux Différentielles ordinaires et aux Différences finies. Par H. POINCARÉ.

A Second Paper on Perpetuants. By Capt. P. A. MACMAHON, R. A.

Prüfung grösserer Zahlen auf ihre Eigenschaft als Primzahlen. Von P. SEELHOFF.

Solvable Irreducible Equations of Prime Degrees. By GEORGE PAXTON YOUNG.

On a Certain Class of Linear Differential Equations. By THOMAS CRAIG.

Sur les Nombres de Bernoulli. Par F. GOMES-TEIXERA.

American Chemical Journal. IRA REMSEN, Editor.

CONTENTS OF VOL. VI, No. 6. BALTIMORE, FEBRUARY, 1885.

On the Acquisition of Atmospheric Nitrogen by Plants. By W. O. ATWATER.

The Chemical Composition of the Products of Roller Milling of Wheat. By CLIFFORD RICHARDSON.

The Time Element in Gluten Determinations. By WM. FREAR.

On the Reduction of Camphor to Borneol. By C. LORING JACKSON.

The Action of Light on Silver Chloride. By SPENCER B. NEWBURY.

Mineralogical Notes. By EDGAR F. SMITH.

Remarks on Schulze's Process for the Quantitative Determination of the Halogens in Aromatic Compounds. By L. P. KINNICUT and R. C. SWEETSER.

Notes on the Hübl Method for the Examination of Oils and Fats. By RUSSELL W. MOORE.

On the Action of Methyl Iodide on Asparagine. By ARTHUR MICHAEL and JOHN F. WING.

Reviews and Reports.

CURRENT INFORMATION.

COURSES OF LECTURES NOT HITHERTO ANNOUNCED.

There will be a course of seven lectures on "Morphological Problems," in the Biological Lecture Room at 4 p. m., on Mondays and Wednesdays during April and May, as follows:

Monday, April 20, *April* 27, *May* 4. Mr. E. A. Andrews.—Anatomy, Embryology, and Affinities of Annelids.
Monday, May 11. Mr. J. Playfair McMurrich.—The Morphological Significance of the Hypoglossus Nerve.
Wednesday, May 13. Mr. A. T. Bruce.—The Embryology of Insects.
Monday, May 18. Dr. W. K. Brooks.—Alternation of Generation.
Wednesday, May 20. Mr. Otto Lugger.—Galls.

Dr. Wm. T. Councilman, Associate in Pathology, will give six lectures on Animal Teratology, or the theory of monstrosities, on Wednesdays from 4 to 5 p. m., commencing on April 1st.

Mr. E. S. Burgess will give during April and May a course of practical instruction in Plant Analysis and other Elements of Systematic Botany.

The class will meet on Mondays and Wednesdays at 11 a. m., commencing on April 1st. The instruction will be such as to meet the needs of beginners.

Jas. W. Bright, Ph. D., will give instruction in Anglo-Saxon Grammar, during March, April, and May. The class will meet on Tuesdays at 5 p. m., and Saturdays at 10 a. m.

NOTE ON LOCAL SANITARY PRECAUTIONS.

March 20, 1885.

To the Board of Trustees of the Johns Hopkins University:

Gentlemen: In reply to your request for information as to the preventive methods which are best adapted to avert or lessen the danger of cholera in this community in the year 1885, we beg leave to offer the following suggestions:

1. The use of contaminated water for drinking purposes should be prevented. All authorities on sanitary matters agree that bad water is one of the most efficient agents in the spreading of many forms of disease, as typhoid fever, cholera, &c. The water of the old pumps in this city is undoubtedly badly contaminated with sewage, and in case of an outbreak of cholera these pumps would be a serious source of danger. They should be closed and put in such condition as to make their use impossible.

2. More than the usual precautions should be taken to secure the cleanliness of the city. A thorough inspection of every house and its surroundings should be made, and energetic measures taken to remove filth of every description.

3. Anything tending to lower the general health of the citizens should be carefully avoided. Extensive digging up of the earth during warm weather, for example, should be avoided as far as possible, as the evidence is very strong that the materials given off when soil saturated with filth is exposed to the air are detrimental to health.

The principles involved in the above statements are so universally recognized that their reiteration is only called for because of prevalent apprehensions.

IRA REMSEN,
H. N. MARTIN,
J. S. BILLINGS.

PROCEEDINGS OF SOCIETIES.

Scientific Association.

March 11.—Sixty-third regular meeting. Professor Martin in the chair. Forty-one persons present.

Papers read:

On the Temperature Sense, by H. H. Donaldson. (*Abstract on p.* 76.)
On the Relation of Antiseptic Power to Chemical Constitution. by J. R. Duggan.
Mr. H. F. Nachtrieb exhibited several specimens and models to illustrate the development of Echinoderms.

April 1.—Sixty-fourth regular meeting. Professor Martin in the chair. Fifty-five persons present.

Papers read:

On the Methods of Measuring Atmospheric Electricity, by P. Morrill.
On a Visual Phenomenon, not hitherto described, by H. N. Martin.
The Results of the Most Recent Work on the Metamorphic and Crystalline Rocks, by G. H. Williams.
Methods for Producing Illustrations for Scientific Papers, by W. K. Brooks.

Philological Association.

March 6.—Sixtieth regular meeting. Professor Gildersleeve in the chair. Forty members present.

Papers read:

On the Final Sentence in Classic Greek Prose, by B. L. Gildersleeve.
This paper, a report and a criticism of Weber's recent work *Entwickelungsgeschichte der Absichtssätze*, is too detailed to present in abstract here. It is expected to appear in the forthcoming number of the *American Journal of Philology*.
On the Persistence of Alliteration in English, by H. Wood.

April 10.—Sixty-first regular meeting. Professor Gildersleeve in the chair. Thirty-eight members present.

Papers read:

On a Eucharistic Sermon by John Chrysostom preserved in Ethiopic, by P. Haupt.
Note on the Catalogue of the Books of the Bible in the MS. of the "Teaching of the Twelve Apostles," by C. Adler.
The English Element in Pennsylvania German, by M. D. Learned.

Historical and Political Science Association.

February 27.—Dr. R. T. Ely in the chair.

The Northwest as a Field for Original Studies, by Albert Shaw.
A Study in Administration, by R. T. Ely.

March 6.—Dr. H. B. Adams in the chair.

Review of the History of the Appointing Power in the United States, by Woodrow Wilson.
The Historical Tripos at Cambridge, England by H. B. Adams.

March 13.—Public session in Hopkins Hall.

The Foreign Relations of the United States, by Honorable Eugene Schuyler.

March 20.—Dr. H. B. Adams in the chair.

Boundary Disputes between Pennsylvania and Maryland, by W. B. Scaife. (*To be published in the Pennsylvania Magazine of History and Biography.*)
Notice of Cassell's Dictionary of English History, by H. B. Adams. (*Published in The Dial* (*Chicago*). *April*, 1885.)
Letter concerning History at Oxford, from Professor E. A. Freeman.

March 27.—Dr. R. T. Ely in the chair.

Recent American Economists, by Woodrow Wilson.
Letter on the Doctrine of Laissez-Faire, from Professor James Bryce, M. P.

April 10.—Dr. H. B. Adams in the chair.

Judicial Procedure in the early New Haven Courts, by C. H. Levermore.
The Question of the first Printing-Press in Maryland, by T. A. Berry.

April 17.—Dr. H. B. Adams in the chair.

Methods of studying History in the College and in the University, by Denman W. Ross.

Mathematical Society.

March 17.—Professor Newcomb in the chair. Sixteen persons present.

Papers read:

On Generalized Quantity, by W. E. Story.
On the theorem, "Every Equation has a Root," by J. F. McCulloch.
On the Extension of Rolle's Theorem to Non-uniform Algebraic Functions, by C. Veneziani. (*Abstract on p.* 78.)

April 15.—Dr. Story in the chair. Eleven persons present.

Papers read:

On the Discriminant of the Equation which Determines the Axes of a Quadric Surface, by F. Franklin.
On the Geodesic Line, by C. Veneziani.
On the Division of Irrational Algebraic Quantity by Real Primes, by A. S. Hathaway. (*Abstract on p.* 79.)

Metaphysical Club.

March 3.—Forty-second regular meeting. Professor G. Stanley Hall in the chair. Fourteen members present.

Papers read:

The Boy in Education, by C. H. Levermore.
Local Facilities for the Study of Mental Diseases, by W. Noyes, Jr.
Final Causes, by M. I. Swift.
Review of recent Psychophysic Studies: (*a*) *Das Gedächtniss*, by Ebbinghaus; (*b*) Indirect Attention, by Krepelin; (*c*) The Programme of the American Society for Psychical Research on Thought Transference,—by G. S. Hall.

ANNOUNCEMENTS RESPECTING FELLOWSHIPS, SCHOLARSHIPS, AND TUITION FOR THE ACADEMIC YEAR, 1885-86.

Scholarships and Fellowships.

The Trustees of the Johns Hopkins University have recently recast the system of scholarships and fellowships upon the following basis. Seventy-eight of these honors are hereafter to be open to young men who are most deserving of choice because of their character and intellectual promise. The new regulations take the place of former arrangements but do not affect appointments already made.

I. Twenty ordinary Hopkins Scholarships (yielding free tuition), to be bestowed by the Board of Collegiate Advisers upon matriculated undergraduate students coming from Maryland, Virginia, and North Carolina; tenable for three years or until the degree of Bachelor of Arts is taken.

II. Eighteen Honorary Hopkins Scholarships (yielding $250 per annum and free tuition); two of them to be annually awarded for uncommon merit, among the matriculated undergraduate students from each of the States above named; tenable for three years or until the degree of Bachelor of Arts is taken,—the selection to be made by the Board of Collegiate Advisers.

III. Twenty University Scholarships (yielding $200 without free tuition); ten of them annually open to Bachelors of Arts of the Johns Hopkins University, and ten of them open to general competition among graduate students studying here; limited to one year, except for unusual considerations,—the selection to be made by the Board of University Studies.

IV. Twenty Fellowships (yielding $500 and free tuition), to be awarded to graduates of this or other institutions, for conspicuous merit; limited to one year, except for unusual considerations,—the selection to be made by the Academic Council.

V. Fellowships by Courtesy, having no emoluments, open to Fellows of other colleges, teachers, and investigators, wishing to engage in study here,—the invitation to be extended by the Academic Council.

I and II.

ORDINARY AND HONORARY HOPKINS SCHOLARSHIPS.

In the will of the founder of the University, his Trustees are requested to "establish, from time to time, such number of free scholarships in the said University as may be judicious, and to distribute the said scholarships among such candidates from the States of Maryland, Virginia and North Carolina, as may be most deserving of choice, because of their character and intellectual promise, and to educate the young men so chosen free of charge."

In accordance with this request the Trustees have established thirty-eight scholarships, of which twenty are designated as ordinary Hopkins Scholarships and eighteen as Honorary Hopkins Scholarships, and they will be awarded in accordance with the following regulations:

1. These scholarships are open to fully matriculated undergraduate students from the States above named.

2. The selection is to be made at the beginning of each academic year, by the Board of Collegiate Advisers, from students who have asked the board to consider them as candidates. The names of successful candidates will be published.

3. The ordinary Hopkins Scholarships yield free tuition; the Honorary Hopkins Scholarships in addition to free tuition yield $250 per annum, payable in five instalments.

4. The scholarships may be held for three years, unless the candidate previously takes the degree of Bachelor of Arts, and is so entitled to become a candidate for the scholarships open to graduates.

5. The scholarships may be forfeited because of prolonged absence, defective scholarship, or unworthy conduct, and the question of continuance shall be annually decided by the appointing board.

6. In case the holder of an honorary scholarship gives it up for any reason, during the course of a session, such part of the stipend will be paid to him as seems equitable to the Executive Committee of the Board of Trustees.

7. Two of the Honorary Hopkins Scholarships are open annually to candidates from each of the States above named.

8. The holders of scholarships are not exempt from laboratory fees.

9. As these scholarships are awarded as honors, successful candidates who are disposed, for the benefit of others or for any other reason, to waive the remission of tuition or the other pecuniary emolument, may do so and still have their names retained on the honor list. Any scholarships thus vacated are open to the candidates next in merit.

[In addition to the scholarships for which provision was made by the founder, the Trustees have established the system of university scholarships and fellowships described in the following statements.]

III.

UNIVERSITY SCHOLARSHIPS.

For the encouragement of scholarship among those who have taken the baccalaureate degree and wish to continue their studies here, twenty graduate scholarships will be awarded annually.

1. Applications addressed to the President must be made by those who wish to be candidates, and they will be examined in different branches of study, according to such regulations as may be determined by the Board of University Studies.

2. Ten of these scholarships will be open in June to young men who have received or who are about to receive the degree of Bachelor of Arts in this University. The remainder will be open about the first of January to graduates of this or of other institutions who have been studying here during the previous part of the session.

3. The emolument of these scholarships will be two hundred dollars, without free tuition. No objection will be made if the holders of these scholarships increase their income by giving lessons, or by rendering services in the library, laboratories, gymnasium, or elsewhere. As a rule the scholarships may be held only for a single year.

4. These scholarships are to be awarded as honors, and those who are disposed, for the benefit of others or for any other reason, to waive the pecuniary emolument, may do so and still have their names retained on the honor list.

5. The Board of University Studies will name the successful candidates, and will reserve appointments if worthy candidates do not offer.

IV.

FELLOWSHIPS.

Twenty fellowships are annually open to competition in this university, each yielding five hundred dollars and exempting the holder from all charges for tuition.

1. The application must be made prior to May 1,* in writing, addressed to the President of the University, and he will refer the papers to the Academic Council, by whom the nominations will be made to the Board of Trustees, at their meeting in June.

2. The candidate must give evidence of a liberal education, such as the diploma of a college of good repute; of decided proclivity towards a special line of study, such as an example of some scientific or literary work already performed; and of upright character, such as a testimonial from some instructor.

3. The value of each fellowship is five hundred dollars in addition to free tuition. In case of resignation, promotion, or removal from the fellowship, payments will be made for the time during which the office shall have been actually held. Payments are made at the Treasurer's office as follows: one hundred dollars on October 1, and fifty dollars each month through the next eight months.

4. Every holder of a fellowship will be expected to perform such duties as may be allotted to him, in connection with his course of study, to act when called upon as an examiner, or as moderator in the examination room, to give all his influence for the promotion of scholarship and good order, and in general to co-operate in upholding the efficiency of the university, as circumstances may suggest. He must reside in Baltimore during the academic year.

5. He will be expected to devote his time to the prosecution of special studies (not professional), under the direction of the head of the department to which he belongs, and before the close of the year to give evidence of progress by the preparation of a thesis, the completion of a research, the delivery of a lecture, or by some other method.

6. He may give instruction, with the approval of the President, by lectures or otherwise, to persons connected with the university, but he may not engage in teaching elsewhere.

7. He may be re-appointed at the end of the year, but only for exceptional reasons.

8. Usually not more than two fellows will be appointed in any department of study.

9. As these fellowships are awarded as honors, those who are disposed, for the benefit of others or for any other reason, to waive the pecuniary emolument, may do so, and still have their names retained on the honor list.

V.

FELLOWSHIPS BY COURTESY.

The Academic Council may, at their discretion, invite persons of the following classes to be enrolled as Fellows by Courtesy.†

(*a*) Gentlemen who are or who have been officers of other institutions, and who wish, for brief periods, to avail themselves of the opportunities here afforded for study and for the use of books and laboratories.

(*b*) Holders of fellowships in other colleges, during their residence here.

(*c*) Those who have been fellows of this University and desire to continue their residence here.

Charges for Tuition, Laboratory Expenses, and Lectures.

Annual Charge for Tuition.

(1). The charge for tuition is one hundred dollars per annum, and those who pay this sum have access to all the privileges of the university (libraries, lectures, laboratories, gymnasium, etc.), without further payment, excepting that charges are made in the laboratories for materials consumed and for instruments and apparatus not returned in good condition.

Tuition is payable in two instalments—fifty dollars on the first of October, and fifty dollars on the first of February.

No deduction is made at the Treasurer's office because of absence for a period of less than a half-year, or because the student gives only a part of his time to study, or because he belongs to but one class.

All fees are payable at the Treasurer's office. The directors of the laboratories will report from time to time the charges to be made.

Caution Money.

(2). Every student is required, before he attends any class, to deposit at the Treasurer's office the sum of ten dollars as caution money, which will be repaid to him when he leaves the university, —if there are no charges against him on the books of the Treasurer's office, the library, the laboratories, or elsewhere. This applies to the holders of scholarships and fellowships as well as to other students.

Laboratory Charges.

(3). In Chemistry and Biology for materials consumed, including chemicals, gas, etc., twenty dollars for the year or ten dollars for the half-year; and for apparatus taken from the laboratory stock and not returned in good condition, the cost thereof.

(4). In Physics charges are made for breakage, but not for materials consumed.

(5). Biological students engaged in investigation or special individual work are charged twenty dollars for the use of instruments, etc., and required to pay for any material consumed, except the usual histological and chemical reagents.

Attendance upon Lectures only.

Young men who have no other relations to the university may be admitted, under varying conditions to be learned in the several departments, to the courses of instruction named below on the payment of the specified fees:

(6). In Chemistry; annual course of lectures extending through the year, without laboratory work, $20.

(7). In Physics; annual course of lectures extending through the year, without laboratory work, $20.

(8). In Biology; annual course of lectures, extending through the year, without laboratory work, $20.

(9). In Animal Physiology; annual course of instruction to medical men and others, $50, which includes the fee for materials consumed in the laboratory.

(10). In Histology; a course of practical instruction, $25, which includes the fee for materials consumed.

(11). In History and Political Science; the two courses on the History of Politics and on Finance and Taxation, $20 (for both), or for one undergraduate course or for membership in the seminary, $20.

Charges (6), (7), and (8) refer to the general introductory courses and not to higher work.

Adopted by the Board of Trustees of the Johns Hopkins University, April 6, 1885.

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* In 1885, applications will be received until May 9.

† An appointment as Fellow by Courtesy does not necessarily carry with it the remission of tuition fees.

INSTRUCTION IN BIOLOGY.

UNDERGRADUATE COURSES.

Undergraduates may be received in the biological classes as—

1. Matriculated students who are candidates for the degree of Bachelor of Arts;

2. As students who do not propose to take the degree of Bachelor of Arts, but who, having passed a special entrance examination, wish to prepare themselves to enter on professional studies in a medical school;

3. As special students, who desire instruction and opportunities for study in some department of Biology.

MATRICULATED STUDENTS.

The requirements for matriculation are given in the University Register.

Matriculated students, who select Biology as one of their main subjects, will be required, in order to obtain the degree of Bachelor of Arts, to complete a course of study extending over at least three years, in accordance with the following schedule.

First Year.

a. Physical Geography, History, English Language and Literature.
b. Physics.
c. Chemistry.
d. Drawing.
e. Physical Culture.

Second Year.

a. Chemistry.
b. Biology.
c. German.
d. Vocal Culture.
e. Physical Culture.

Third Year.

a. Biology.
b. French.
c. Logic, Ethics and Psychology.
d. Theory of Accounts.
e. Physical Culture.

The courses marked *a*, *b*, *c*, include, respectively, five class exercises weekly, each of an hour's duration, and some laboratory or other work outside of the class room. The time required for the satisfactory completion of each course may be estimated at fifteen hours a week for a student of average ability.

The courses marked *d*, in each year, include one or two exercises weekly.

The course *e* includes regular exercise in the gymnasium for all students who do not satisfy the instructor in physical culture that they do not need it for hygienic reasons.

PRELIMINARY MEDICAL STUDENTS.

Undergraduates who have not matriculated and who desire to pursue a course of study preparatory to entrance at a medical school will be required to pass a special entrance examination. The subjects of the examination are—

Elementary Mathematics. Arithmetic; Algebra; three books of Euclid, or an equivalent amount of Geometry (four books of Chauvenet); Plane Trigonometry, and the use of Logarithms.

The examination in Algebra will be confined to the following: definitions and explanations of algebraical signs and terms; addition, subtraction, multiplication and division of algebraical quantities; ratio, proportion and variations; simple equations involving not more than two unknown quantities.

Latin. Translation of passages from the first four books of Cæsar, *De Bello Gallico*, and from the sixth book of the Æneid; the elements of Latin Grammar, especially Accidence.

Candidates who obtain permission at least a fortnight previously, will be allowed to offer themselves for examination in equivalent portions of other Latin classics.

English. Proficiency in English Grammar and Analysis, and a knowledge of the outlines of the History of the English Language are required.

Each student must give further evidence of ability to use the English Language with correctness and propriety in English Composition. Bad penmanship will be regarded as a serious defect.

Whitney's Essentials of English Grammar and Lounsbury's History of the English Language (Introduction and first eight chapters), are recommended for use in preparation.

History. The outlines of the History of England and of the United States.

Thompson's England and Doyle's United States are named to indicate the knowledge required.

Physical Geography. Guyot's Physical Geography and Huxley's Physiography are recommended as text-books.

After the entrance examination has been passed, the studies in the preliminary medical course are the same as those prescribed for matriculated students who select Biology as one of their main subjects of study.

SPECIAL STUDENTS.

As regards special students desiring admission to the biological classes no general rule can be formulated, except that no one will be admitted to the classes in General Biology or Physiology (see below) who has not a fair knowledge of the elements of Chemistry and Physics. It may be added that, in general, young men of the usual age of college undergraduates will only be received as special students in Biology after passing an examination designed to test whether they possess a good school education.

The admission of older students and of those who may have given evidence of special aptitude for biological studies, will be decided after consideration of the circumstances of each case. The desire of the University authorities is to give the best opportunities to all who can show good reason why they should devote their time mainly to biological studies, but also to discourage youths who should be getting a good general education at school or college from neglecting it, in order to enter too early on specialized studies.

THE UNDERGRADUATE COURSE IN BIOLOGY.

The regular course of biological instruction extends over two years, but those who take Biology only as a subsidiary subject for the B. A. degree are not required to do more than the first year's work.

First Year.

The subjects of study during the first year have been planned to meet the needs (1) of those who intend ultimately to take up some branch of Biology (Zoölogy, Physiology, or Botany) for special study; (2) of students, graduate or undergraduate, who expect later to study medicine, but meanwhile desire, as a valuable preparation, to obtain some general knowledge of the phenomena, laws, and conditions of life; (3) of those who wish to acquire as a part of their general college training, some acquaintance with the methods of modern experimental and observational science, and select Biology as a subject of study with that end in view. The following subjects are included in this year's work:

1. *General Biology.*

Three lectures or recitations weekly from the commencement of the session until the end of March.

Attention is directed to the broad characteristic phenomena of life and living things rather than to the minutiæ of descriptive Botany or Zoölogy, or to the characters of orders, genera, and species. In the laboratory the student learns how to observe, how to verify and describe what he observes, how to dissect, and how to use a microscope; he examines selected vegetable and animal types, from unicellular organisms, such as the yeast plant and amœba, to the fern and the flowering-plant on one side, and to the crayfish and a mammal on the other. In the lecture room attention is mainly given to the fundamental biological facts and laws which the particular plant or animal under consideration is fitted to illustrate, the object being rather to give the student an idea of what is meant by the terms living thing, plant, animal, tissue differentiation, life history, organ, function, etc., than to teach him the elements of Botany and Zoölogy as commonly understood. The organisms studied are Torula, Protococcus, Amœba, Micrococcus, Bacterium, Spirillum, Bacillus, Penicillium, Mucor, Spirogyra, Nitella, a moss, a fern, a flowering-plant, Infusoria, Hydra, starfish, earth-worm, crayfish, clam, frog. terrapin, pigeon, and rat; so that at the close of the course the student has a practical knowledge of the structure and life conditions of a typical example from most of the main divisions of plants and animals, on which to base his more theoretical studies.

2. *Osteology, Human and Comparative.*

Two lectures or recitations weekly until the end of March, with practical study on selected skeletons.

The student begins with the human skeleton, which, as the most minutely and accurately described of all conveniently accessible animal structures, is well fitted to train him to observe closely and accurately. He then studies a skeleton from each of the chief orders of the Mammalia and two or three from each of the remaining main groups of Vertebrata.

3. *The Embryology of the Chick and Mammal.*

Three lectures or recitations weekly from the beginning of April until the close of the session, with practical study of the development of a bird.

In this course the student, who has already in his General Biology observed the natural arrangement of animals and plants in diverging series advancing from a simple bit of living matter to highly complicated organisms, studies the individual development of one of the higher animals, from the start as an almost formless bit of protoplasm to its final highly complex structure. The increasing differentiation of tissues and organs which he has noted as higher and higher plants and animals were dissected, he now sees exemplified by the chick embryo in different stages of development. At the same time a good foundation is laid for subsequent advanced study in Vertebrate Morphology.

4. *Plant Analysis and the elements of Systematic Botany.*

Practical instruction twice weekly from the beginning of April until the close of the session.

The student is taught how to collect and preserve plants; and by the analysis of a number of flowering plants under the direction of his teacher, gets a good introduction to the terminology of descriptive botany, and learns how to use a botanical key for the recognition of species.

Second Year.

In this year some choice is permitted to the student. He may select as his chief subject Animal Physiology and Histology or Animal Morphology (Comparative Anatomy). Botany will ultimately be offered as another elective.

The physiological division of the second year's work in Biology is especially recommended to all who intend to study Medicine or Psychology. It includes the following subjects:

1. *Animal Physiology and Histology.*

Three class exercises weekly, with Laboratory work, throughout the academic year.

This course is designed to give the student a good knowledge of the properties and mode of working in health of the various tissues and organs of the higher animals, man included; also to make him acquainted with their microscopic structure. It thus prepares the student for subsequent study of Pathology and Pathological Histology. In the laboratory each student examines for himself the histology of each organ and tissue, and learns the use of reagents and embedding materials, the methods of cutting and mounting sections, etc.; he also studies practically the composition of the more important organs and tissues, the chemistry of digestion, the fundamental properties of living muscles and nerves, the beat of the heart, the phenomena of reflex action, etc. Important physiological facts, which require special skill for their exhibition or the employment of exceptionally delicate instruments, are demonstrated to the class. There will be, as a rule, one such demonstration weekly. No painful experiments are performed in connection with this course.

The physiological apparatus belonging to the University is unusually good and complete; students have, accordingly, not only the opportunity to acquire a knowledge of the methods of modern histological investigation, but also of the mode of using all the chief instruments employed in physiological, pathological, and pharmacological research.

2. *Mammalian Anatomy.*

Twice weekly, until Christmas.

In connection with this course the student dissects one of the higher mammals with the minuteness with which the human body is dissected in a medical school. He thus not merely learns how to dissect, but acquires a knowledge of the names, general distribution, and structure of the muscles, nerves, vessels, and viscera; and becomes fitted to take up profitably the professional study of the details of descriptive and regional Human Anatomy, thus saving much time when he afterwards enters a medical school.

3. *Elements of Zoölogy.*

Two lectures or recitations weekly from the beginning of January until the end of the academic year.

A systematic course of lectures on the structure, relationships, and classification of animals. In the laboratory the student dissects a number of types selected to supplement the forms studied in the General Biology course of the first year.

These types are—

Calcareous sponge; tubularian hydroid; hydro-medusa; actinia; starfish and its development; sea urchin and its development; holothurian; polychaetous annelid; leech; distoma; copepod; barnacle; crab, and its metamorphosis; limulus; scorpion; grasshopper; gasteropod; cephalopod; lingula; ascidian; amphioxus; shark; teleost; lizard.

The morphological division of the second year's work includes the following:

1. *Mammalian Anatomy.*

As prescribed for the physiological division.

2. *Elements of Zoölogy.*

As prescribed for the physiological division.

3. *Work at the Marine Laboratory.*

This must extend over at least two months, and may not be undertaken before the completion of the first year's biological studies. The marine laboratory is only open during June, July, and August in each year.

GRADUATE AND ADVANCED INSTRUCTION.

Opportunities for advanced study and for research are provided for graduates who have already such a knowledge of Biology as might be obtained by following the two years' collegiate course in that subject, and for others who, although not graduates, satisfy the authorities that they are competent. In the university courses but little of the teaching is given by formal lectures; the instructors come into close daily contact with the students, supervise their work, direct their researches, and advise as to their reading.

1. *Animal Physiology.*

The new biological laboratory has been especially constructed with reference to providing opportunity for advanced work in experimental physiology. The collection of physiological instruments belonging to the University is unusually large and complete and is yearly added to,—the Trustees providing an annual sum for the purchase of instruments wanted for any particular investigation, or which, for other reasons, it is desirable to have in the laboratory. There is also a workshop in the laboratory in which a skilled mechanic is kept employed repairing and constructing instruments. The laboratory contains two large rooms for general advanced work in animal physiology, in addition to others specially designed for work with the spectroscope, with the myograph, for electro-physiological researches, and for chemical physiology.

2. *Animal Histology.*

The laboratory contains a special room constructed for advanced histological work, and well supplied with apparatus and reagents. There is also a room and apparatus for micro-photography.

3. *Animal Morphology.*

Rooms for advanced work in this subject are contained in the laboratory and a course of advanced lectures is given by Professor Brooks. Much of the advanced study in animal morphology is however carried on at the Marine Laboratory, open at the seaside from the beginning of June until the end of August, under the direction of Dr. Brooks. The Marine Laboratory possesses a steam launch and a large sloop, and is supplied with dredges, boats, aquaria, microscopes, etc.

4. *Physiological Psychology.*

During the academic year a course of lectures, combined with laboratory work, is given by Professor G. Stanley Hall, in connection with the psychological courses of instruction in the university.

5. *Lectures.*

Short advanced courses of lectures are given from time to time on selected physiological and morphological subjects.

6. *Journal Club.*

A Journal Club, composed of the instructors and advanced students, meets weekly for the reading and discussion of recent biological publications.

7. *Library Facilities.*

The laboratory contains a library supplied with standard biological works and complete sets of the more important journals. There is also a special collection of books which have been brought together in connection with researches carried on in the laboratory. An effort is always made to procure for anyone engaged in a particular investigation all publications bearing on his work and not easily accessible, as graduation theses, occasional publications from laboratories in Europe and elsewhere, etc. The library receives regularly about forty biological periodicals, including all the important physiological and morphological journals in English, French, German, and Italian.

The general library of the University receives regularly the chief journals of general science, and the transactions of all the leading learned societies of the world.

The Library of the Peabody Institute, within five minutes walk of the University, contains complete sets of many of the chief biological journals, of the proceedings of learned societies; and other works of reference.

In the library of the Medical and Chirurgical Faculty of Maryland, a very large number of medical periodicals is accessible to members of the University.

The proximity of Washington is of special value to advanced students of physiology. The Library of the Army Medical Museum in that city contains an almost unrivalled store of physiological works which are available under conditions favorable to study.

8. *Publication.*

In connection with the biological laboratory there is published a journal ("*Studies from the Biological Laboratory*") which contains the results of most of the researches carried out in the laboratory; a ready means of publication for original work is thus secured. The *University Circulars*, which appear at brief intervals throughout the year, are available for preliminary statements, securing priority for discoveries while more detailed accounts are in course of publication.

NATURALISTS' FIELD CLUB.

This was organized by members of the University, but includes in its list of members other residents of Baltimore interested in Natural History. The club works in three sections—Geology and Mineralogy, Zoölogy, Botany. Each section elects its own officers and arranges for its own field excursions and its own meetings. There are also monthly meetings of the whole club, when the chairmen of the different sections report progress and an address on some topic of Natural History is given by one of the members.

The mineralogical collections of the club are preserved in the Chemical Laboratory; the botanical and zoölogical in the Museum of the Biological Laboratory.

[This Number is especially devoted to the Programmes for the Next Academic Year and to Statements of the Work of the Past Year].

JOHNS HOPKINS UNIVERSITY CIRCULARS

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PROGRAMMES FOR 1885-86.

The following courses in literature and science are offered for the academic year which begins October 1, 1885. They are open to properly qualified young men according to conditions varying somewhat in each department. Detailed statements as to the various subjects are given in the programmes of the departments of instruction on subsequent pages. The Annual Register giving full statements as to the regulations and work of the University will be sent on application.

B. L. GILDERSLEEVE, *Professor of Greek.*

(*a*) will direct the Greek Seminary. *Twice weekly, through the year.*
(*b*) will conduct a course of Practical Exercises in Greek. *Twice weekly, from October to January.*
(*c*) will give a course of lectures on Greek Syntax. *Through the year.*
(*d*) will hold a series of Conferences on Greek Literature. *Weekly, after the spring recess.*

G. STANLEY HALL, *Professor of Psychology and Pedagogics.*

(*a*) General Systematic Psychology. *Semi-weekly lectures and weekly conferences.*
(*b*) Pedagogics. *A weekly lecture and a weekly conference.*
(*c*) History of Philosophy. *Twenty-five lectures.*

PAUL HAUPT, *Professor of the Shemitic Languages.*

(*a*) Hebrew, Biblical Aramaean, and Syriac. *Through the year.*
(*b*) Ethiopic. *Weekly, through the year.*
(*c*) Arabic. *Twice weekly, through the year.*
(*d*) Assyrian, Babylonian, Akkadian, and Sumerian.

H. N. MARTIN, *Professor of Biology.*

(*a*) will direct the Laboratory Work in Biology. *Daily, through the year.*
(*b*) will lecture on General Biology. *Three times weekly, till April.*
(*c*) will lecture on the Embryology of the Chick and Mammal. *Three times weekly, from April till close of session.*
(*d*) will lecture on Animal Physiology and Histology. *Three times weekly, through the year.*

C. D. MORRIS, *Collegiate Professor of Greek and Latin.*

(*a*) Cicero, Lucretius, Tacitus. *Four times weekly, through the year.*
(*b*) Demosthenes, Sophocles, Aristophanes. *Four times weekly, through the year.*
(*c*) Greek Prose Composition, Reading Latin at sight, Latin Prose Composition. *Each weekly, through the year.*

SIMON NEWCOMB, *Professor of Mathematics and Astronomy.*

(*a*) Mathematical Seminary. *Weekly, through the year.*
(*b*) Practical and Theoretical Astronomy. *Twice weekly, through the year.*

IRA REMSEN, *Professor of Chemistry.*

(*a*) will direct the Laboratory Work in Chemistry. *Daily, through the year.*
(*b*) will lecture on General Chemistry. *Daily, first half-year.*
(*c*) will lecture on the Compounds of Carbon. *Daily, second half-year.*
(*d*) will lecture on advanced topics in Chemistry. *First half-year.*

H. A. ROWLAND, *Professor of Physics.*

(*a*) will direct a course of advanced work in the Physical Laboratory. *Daily, through the year.*
(*b*) will lecture on Thermodynamics, Heat Conduction, and Physical Optics. *Four times weekly, through the year.*

H. B. ADAMS, *Associate Professor of History.*

(*a*) Seminary of History and Politics. *Weekly, through the year.*
(*b*) History of Politics. *Twice weekly, through the year.*

(*c*) Modern Course in History. *Daily, through the year, with an associate instructor.*
(*d*) International Law and Modern Constitutions. *Daily, through the year, with an associate instructor.*

M. BLOOMFIELD, *Associate Professor of Sanskrit.*

(*a*) Sanskrit, elementary, (*twice weekly*), second year, (*twice weekly*), advanced, (*weekly*). *Through the year.*
(*b*) General principles of Comparative Philology, Comparative Greek Grammar.
(*c*) The formation and syntax of Indo-European noun compounds.

W. K. BROOKS, *Associate Professor of Morphology.*

(*a*) will direct the work of the Marine Laboratory at Beaufort.
(*b*) will lecture on the Elements of Zoölogy. *Twice weekly, from the Christmas recess until the end of the session.*
(*c*) will conduct a course in Animal Morphology.

T. CRAIG, *Associate Professor of Applied Mathematics.*

(*a*) Mathematical Seminary. *Weekly, through the year.*
(*b*) Theory of Sound, Spherical Harmonics and Theory of Attractions, Theory of Functions. *Eight times weekly, first half-year.*
(*c*) Linear Differential Equations, Abelian Functions, Partial Differential Equations. *Eight times weekly, second half-year.*
(*d*) Differential Equations. *Twice weekly, through the year.*

A. M. ELLIOTT, *Associate Professor of Romance Languages.*

will give advanced courses in the Romance Languages, including Old and Middle French, Old Provençal, Italian, Spanish and Portuguese Texts, Wallachian, Low Latin, etc.

H. N. MORSE, *Associate Professor of Chemistry.*

(*a*) will assist in directing the Laboratory Work of the undergraduate students in Chemistry.
(*b*) will lecture on Analytical Chemistry. *Four times weekly, first half-year.*
(*c*) will conduct a course in General Chemistry. *Three times weekly, second half-year.*

L. RABILLON, *Lecturer on French Literature.*

will give a series of lectures on French Literature (in French).

W. E. STORY, *Associate Professor of Mathematics.*

(*a*) Mathematical Seminary. *Weekly, through the year.*
(*b*) Introductory course for Graduates. *Daily, through the year.*
(*c*) Advanced course in Analytical Geometry. *Three times weekly, through the year.*
(*d*) Finite Differences, Interpolation, and Probabilities. *Twice weekly, through the year.*
(*e*) Conic Sections. *Twice weekly, through the year.*

M. WARREN, *Associate Professor of Latin.*

(*a*) will conduct the Latin Seminary. *Twice weekly, through the year.*
(*b*) will lecture on the Roman Historians, (*first half-year*), Historical Latin Grammar, (*second half-year*).
(*c*) will conduct a course for the Translation at Sight of Latin writers, (*first half-year*), Practical Exercises in translation at dictation, (*second half-year*). *Weekly.*
(*d*) Terence, Plautus, Pliny, Juvenal. *Three times weekly, through the year.*
(*e*) Reading Latin at sight, Latin Prose Composition. *Each weekly, through the year.*

G. H. WILLIAMS, *Associate Professor of Mineralogy.*

(*a*) Introduction to Crystallography and Descriptive Mineralogy. *Twice weekly, second half-year.*
(*b*) Descriptive Mineralogy (second year's course). *Weekly, first half-year.*
(*c*) Mineralogy of the Silicates, (*first half-year*), General Mineralogy and Inorganic Geology, (*second half-year*).

H. WOOD, *Associate Professor of German.*

(*a*) will have charge of the instruction in German.
(*b*) will conduct the advanced courses in German, including the German Seminary, Middle Low German, Gothic, Old Norse, Middle High German, etc.

W. HAND BROWNE, *Associate in English.*

(*a*) Elizabethan, Fourteenth Century, Eighteenth Century, and recent Writers. *Four times weekly, through the year.*
(*b*) Synoptical Study of English Literature. *Twice weekly, through the year.*

R. T. ELY, *Associate in Political Economy.*

(*a*) Political Economy and Modern Social Problems. *Daily, through the year.*
(*b*) Advanced Political Economy. *Twice weekly, through the year.*
(*c*) Comparative Studies in Administration. *Weekly, through year.*

F. FRANKLIN, *Associate in Mathematics.*

(*a*) Problems in Mechanics. *Twice weekly, through the year.*
(*b*) Differential and Integral Calculus. *Three times weekly, through the year.*
(*c*) Theory of Equations, (*first half-year*), Solid Analytical Geometry, (*second half-year*). *Three times weekly.*
(*d*) Preparation for Matriculation in Trigonometry and Analytical Geometry.

E. M. HARTWELL, *Associate in Physical Training.*

will have charge of the Gymnasium and will direct the courses in Physical Culture.

A. L. KIMBALL, *Associate in Physics.*

(*a*) will direct the course of instruction for undergraduates in General Physics, including experimental lectures, recitations, etc. *Daily, through the year.*
(*b*) will give courses of lectures to the major course students. *Daily, through the year.*

H. A. TODD, *Associate in Romance Languages.*

(*a*) Undergraduate courses in French. *Daily, through the year.*
(*b*) Italian and Spanish.

J. W. BRIGHT, *Instructor in English.*

(*a*) Oldest English Texts, Historical English Grammar, Seminary. *Daily, through the year.*
(*b*) Elements of Phonetics, History of English Language, Anglo-Saxon, and First English Literature. *Three times weekly, through the year.*

For the work of other Instructors and Assistants reference may be made to the subjoined statements, and to the Register.

MATHEMATICS.

PROGRAMME FOR 1885-86.

I. Graduate Courses.

PROFESSOR NEWCOMB:

Seminary.
Weekly, through the year.

Practical and Theoretical Astronomy.
Twice weekly, through the year.

DR. STORY:

Seminary.
Weekly, through the year.

The exercises of this Seminary will consist of original work by the students, under the guidance of the Director, on a prescribed subject. The students are expected to make weekly reports of progress, which will be discussed, and from time to time new lines of research will be suggested. The subjects for investigation during the ensuing year will probably be special topics in the Geometry of Higher Curves and Surfaces.

Introductory Course for Graduates (including Mechanics, Theory of Numbers, Modern Algebra, Higher Plane Curves, Surfaces and Twisted Curves, Quaternions, Calculus of Operations, Probabilities, Partial Differential Equations, and Elliptic Functions).
Daily, through the year.

This course is intended as preparatory to all the advanced courses, and candidates for the Doctor's degree in Mathematics are expected to take it in the first year of their candidacy, if they have not previously taken it.

Advanced Course in Analytic Geometry (including applications of the general theory to curves and surfaces of the third and fourth orders).
Three times weekly, through the year.

Finite Differences, Interpolation, and Probabilities.
Twice weekly, through the year.

DR. CRAIG:

Seminary.
Weekly, through the year.

The subjects to which attention will be specially directed are the theory of doubly periodic functions, and linear differential equations, with singly and doubly periodic coefficients, particularly Lamé's and other allied equations. The work will be divided into three parts: solution of problems, the historical investigation of the above-mentioned subjects, and reports on current mathematical journals.

Theory of Sound.
Three times weekly, first half-year.

Spherical Harmonics and Theory of Attractions.
Twice weekly, first half-year.

Theory of Functions.
Three times weekly, first half-year.

Linear Differential Equations.
Three times weekly, second half-year.

Abelian Functions.
Three times weekly, second half year.

Partial Differential Equations.
Twice weekly, second half-year.

DR. FRANKLIN:

Problems in Mechanics.
Twice weekly, through the year.

Mathematical Society.

The Mathematical Society, composed of the instructors and advanced students, will meet monthly as heretofore for the presentation and discussion of papers and oral communications.

II. Undergraduate Courses.

FIRST YEAR:

Conic Sections.
Twice weekly, through the year. DR. STORY.

Differential and Integral Calculus.
Three times weekly, through the year. DR. FRANKLIN.

SECOND YEAR:

Differential Equations.
Twice weekly, through the year. DR. CRAIG.

Theory of Equations.
Three times weekly, first half-year. DR. FRANKLIN.

Solid Analytic Geometry.
Three times weekly, second half-year. DR. FRANKLIN.

Preparation for Matriculation in Trigonometry and Analytic Geometry.
Three or four times weekly, through the year. DR. FRANKLIN.

WORK OF THE PAST YEAR, 1884-85.

Professor Newcomb:

Analytical and Celestial Mechanics. *Twice weekly, through the year.*
Seminary. *Weekly, second half-year.*

Dr. Story:

Seminary. *Weekly, through the year.*
Theory of Numbers. *Twice weekly, first half-year.*
Quaternions. *Three times weekly, second half year.*
Modern Synthetic Geometry. *Three times weekly, first half-year.*
Modern Algebra. *Twice weekly, second half year.*
Introductory Course for Graduates. *Daily, through the year.*
Conic Sections. *Twice weekly, through the year.*

Dr. Craig:

Seminary. *Weekly, through the year.*
Calculus of Variations. *Twice weekly, first half-year.*
Differential Equations. *Twice weekly, through the year.*
Theory of Functions. *Three times weekly, through the year.*
Hydrodynamics. *Three times weekly, first half-year.*
Linear Differential Equations. *Three times weekly, second half-year.*

Dr. Franklin:

Problems in Mechanics. *Twice weekly, through the year.*
Theory of Equations. *Three times weekly, first half-year.*
Differential and Integral Calculus. *Three times weekly, through the year*
Solid Analytic Geometry. *Three times weekly, second half-year.*
Analytical Geometry. *Twice weekly, first half-year; three times weekly, second half-year.*
Trigonometry. *Three times weekly, first half-year.*

Mr. Nixon.

Differential and Integral Calculus (specially designed for students of Physics). *Daily, first half-year.*

Three numbers of the seventh volume of the AMERICAN JOURNAL OF MATHEMATICS have been issued during the academic year and the last number of the volume is now in press.

PHYSICS.

PROGRAMME FOR 1885-86.

The courses in Physics are arranged to meet the wants not only of undergraduates, but also of those who are prepared for advanced work and wish to make Physics a specialty. Graduates and others wishing to take the advanced course and who have not already pursued the equivalent of the undergraduate course, will be required to take so much of it as may seem desirable.

I. Advanced Courses.

1. *Lectures.*

Professor Rowland:

Thermodynamics, Heat Conduction, and Physical Optics, including the electro-magnetic theory of light.
Four lectures weekly, through the year.

Dr. Craig:

Theory of Sound.
Three times weekly, first half-year.

Dr. Story:

Mechanics. (In the introductory course in Mathematics for graduates).
Five times weekly, during the first part of the year.

Dr. Franklin:

Problems in Mechanics.
Twice weekly, through the year.

(All special students in Physics are expected to take both the above courses in Mechanics).

2. *Journal Meeting.*

All advanced students are expected to meet with the instructors once a week for the reading and discussion of the current physical journals. To each student is assigned one of these upon which to report during the year, giving a synopsis of the most important articles.

3. *Laboratory Work.*

The Physical Laboratory is furnished with apparatus purchased from the best European and American makers, selected with special reference to investigations, and especially valuable for researches in electricity, magnetism, light, and heat. The laboratory will be open for work from 9 a. m. till 5 p. m. daily throughout the year. The construction of a new building is to begin at once.

Advanced students are expected to give as much of their time as possible to laboratory work. This will consist at first in carrying out experiments which familiarize them with exact measurement and with experimental methods. When sufficient experience of this kind has been acquired, the student undertakes, under the guidance of the instructors, some research designed to be of permanent value.

II. Undergraduate Courses.

The complete undergraduate course in Physics extends over two years. For the first year's course a knowledge of plane trigonometry and the use of logarithms is required, while for the second year the student must possess an elementary knowledge of analytic geometry and calculus.

FIRST YEAR:

1. Elementary Mechanics, Heat, Electricity and Magnetism, Sound and Light.
   Lectures and recitations daily, through the year. Dr. Kimball.
2. Laboratory work, consisting of simple experimental problems supplementing the class-room work.
   Three hours weekly, through the year. Dr. Perkins.

SECOND YEAR:

1. Mechanics.
   Elementary Thermodynamics.
   Theory of Electricity.
   Problems in Sound.
   Wave Theory of Light.
   Daily, through the year. Dr. Kimball.
2. Laboratory Work.
   Four hours weekly, through the year. Dr. Perkins.

WORK OF THE PAST YEAR, 1884-85.

The rooms devoted to the Physical Laboratory have been open daily for the prosecution of study and research, under the direction of Professor Rowland, assisted by Drs. Kimball and Perkins.

A photographic map of the spectrum has been nearly completed, and special preparations have been made for the exact measurement of wave lengths. These preparations have involved the construction of a comparator, a fine micrometer and a spectrometer with telescopes having six and a quarter inch objectives and eight feet focal length.

The following researches have also been carried on during the year:

The investigation of displacement currents by electro-magnetic means.

The determination of the expansion of water between zero and forty degrees centigrade.

The preparation and study of standard cells.

The measurement of wave lengths of light in absolute measure.

During the month of October a course of twenty lectures on *Molecular Dynamics* was given by Sir William Thomson, D. C. L., F. R. S., &c., Professor of Physics in the University of Glasgow. These lectures were especially intended to develop the mechanics of the molecule in its relations to the luminiferous ether, and were attended by a number of professors and special students of physics from all parts of the country. Stenographic notes of the lectures were taken by Mr. A. S. Hathaway, and have since been written out and published.

Advanced students have taken part with the instructors in weekly meetings for the discussion of the current physical journals.

The following courses have also been carried on during the year:

Professor Rowland:

Lectures on Electricity and Magnetism. *Four times weekly, through the year.*

Dr. Kimball:

First year's course in General Physics. *Daily, through the year.*
Elementary Thermodynamics. *Weekly for eleven weeks.*
Theory of Electricity. *Twice weekly for ten weeks.*
Physical Optics. *Twice weekly for ten weeks.*

Dr. Perkins:

Laboratory work of the undergraduate students throughout the year.

CHEMISTRY.

PROGRAMME FOR 1885-86.

The courses in Chemistry are intended to meet the wants (1) of graduates who make Chemistry their specialty, or who select it as one of their subordinate subjects for the degree of Doctor of Philosophy; (2) of undergraduate students who study Chemistry for general training; (3) of special students who for good reasons have neither received a bachelor's degree nor matriculated at this University. The first and second years' courses are designed mainly for undergraduates, though graduates and special students who have not done an equivalent amount of work will be required to follow such portions of these courses as may seem desirable.

I. Advanced Work.

1. Laboratory Work.

Most of the work of advanced students is carried on in the laboratory, which will be open to them daily, except Saturday, from 9 a.m. until 5 p.m. The work, which will consist in making difficult and typical preparations and in carrying out investigations on assigned topics, will be wholly under the direction of Professor Remsen.

2. General Lectures. (By Professor Remsen).

Advanced topics will be treated in lectures which will be given during the first half-year. Specific announcements will be made later.

3. Historical Lectures.

During the second half-year there will be a course of about twenty lectures on historical topics selected and assigned by Professor Remsen to Fellows and other advanced workers in the chemical laboratory.

This work, while serving to familiarize students with chemical literature, is intended also to aid them in acquiring the art of presenting subjects in the form of lectures before audiences. All those who look forward to the career of teachers of chemistry will be required to take active part in the exercises.

4. Journal Meetings.

The instructors and advanced students will meet once or twice a week for the purpose of hearing reports on the articles contained in the current journals of chemistry.

The reports are furnished in turn by all who attend the meetings. All the principal chemical journals are read and reported upon.

II. Undergraduate Courses.

FIRST YEAR:

This consists of laboratory work and lectures or recitations.

1st Half-Year: Introduction to General Chemistry.
Lectures and examinations daily except Saturday (by Professor Remsen).
Laboratory Work.
Three times weekly, laboratory open from 1 *to* 4 *p.m., Monday, Tuesday, and Thursday.* Work under the direction of Professor Remsen, Dr. Morse, and an assistant.

2nd Half-Year: General Chemistry.
Conversational exercises supplementary to the course of the first half-year; *three times weekly* (by Dr. Morse).
Laboratory Work.
As above, continued.
Mineralogy.
Introduction to Crystallography and Descriptive Mineralogy; *twice weekly* (by Dr. Williams).

SECOND YEAR:

The second year's course is a continuation of that just described; together they form what is known as the Major Course.

1st Half-Year: Analytical Chemistry.
Lectures and examinations four times weekly (by Dr. Morse).
Descriptive Mineralogy.
Once weekly (by Dr. Williams).
Laboratory Work.
Daily except Saturday, 2–5 *p.m.* (under the direction of Professor Remsen and Dr. Morse).

2nd Half-Year: Chemistry of the Compounds of Carbon.
Lectures and examinations daily except Saturday, (by Professor Remsen).
Laboratory Work.
As above, continued.

III. Applied Chemistry.

Opportunity will be offered for work in Applied Chemistry in almost any direction. Some instruction will be given in the assaying of ores. The object of this work is not to make assayers in the narrow sense of the word, nor mere analysts of certain products, but to afford the thoroughly trained chemist an opportunity to familiarize himself with some of the more important applications of his science. Only the most advanced students will be permitted to undertake work of this kind.

WORK OF THE PAST YEAR, 1884-85.

The Chemical Laboratory is a new building which covers an area of about 50 by 100 feet and has three full stories and a basement. In the basement are the necessary conveniences for assaying and other furnace operations. On the next floor there are large rooms devoted mainly to qualitative and quantitative analysis. On the second floor, are the rooms for research work, those of the director, the library, and a lecture-room for General Chemistry. On the third floor, are rooms for the chemical and mineralogical collections, a working and lecture-room for mineralogy, and a second lecture-room for chemistry. The laboratory will conveniently accommodate about ninety working students.

Advanced students have been engaged daily in the laboratory in prosecuting such work as seemed best adapted to the purposes of each. Those who have completed the full courses in General Chemistry, including from two to three years' work in qualitative and quantitative analysis and about a year's work in making difficult and instructive preparations, were encouraged to undertake the solution of original problems.

The following investigations have been or in progress during the year:

On chemical action in a magnetic field.

The effect of pressure on the transformation of a diazo-compound by boiling with alcohol.

The structure of benzoic sulphinide.

On para-brom-benzoic sulphinide.

On the relative stability of halogen derivatives of the paraffins in the presence of an alkali.

A method for the estimation of zinc dust.

An apparatus which enables students to determine the equivalents of certain metals.

An apparatus for distilling mercury in a vacuum.

The results of these investigations have either been already published or will soon appear in the *American Chemical Journal.* Some of them have been read before the Johns Hopkins Scientific Association at its regular meetings.

The Fellows and other advanced students have met the instructors twice a week during the year for the purpose of keeping abreast of the current chemical literature. All the important journals have been carefully read, and full reports of the various articles have been made.

These students have been often called upon to treat important chemical questions in a broad way, going to the original sources and presenting the results in a complete form. In most cases the topics so investigated have been connected with the experimental work going on at the time; but other questions also have been elaborated in this way which bore less directly on the current studies. In several cases carefully written reports of the results obtained have been prepared. The excellent library of chemical books and journals which is accessible to the students in the laboratory, at all reasonable hours, has greatly facilitated the execution of this very desirable literary work.

At the beginning of the year subjects were assigned to the Fellows and others for the preparation of lectures on various chemical topics treated historically; and sixteen such lectures were the result. These were prepared from a careful study of the original articles in the journals, and were not borrowed from books on the history of chemistry. Full abstracts of these lectures, furnished with complete references to the articles consulted, are to be prepared and preserved in the chemical library. The lectures given were as follows:

Two by Professor Remsen on "The Basicity of Acids";
One by Dr. J. R. Duggan on "Disinfecting Agents";
One by Mr. W. S. Bayley on "The History of Uric Acid";
Two by Dr. D. T. Day on "Dissociation";
One by Mr. C. S. Palmer on "The Proust-Berthollet Controversy";
Two by Dr. Morse on "The History of Phosphorus";
One by Mr. A. G. Palmer on "Isomerism in the Benzene Series";
One by Mr. H. W. Hillyer on "Homology";
Two by Dr. E. H. Keiser on "The History of Pyridine and Quinoline";

These lectures were attended by an average of twenty-five persons including the instructors.

In addition, the work of the year has consisted of the courses below mentioned:

Laboratory Work through the entire year, conducted by Professor Remsen, Dr. Morse and Dr. E. H. Keiser.

Lectures by Professor Remsen:
  General Chemistry, *daily, first half year.*
  Chemistry of the Compounds of Carbon, *daily, second half year.*
  Chemical Philosophy, *twelve lectures, first half-year.*

Courses by Dr. Morse:
  Analytical Chemistry, *four times weekly, first half-year.*
  General Chemistry, *three times weekly, second half-year.*

Courses by Dr. Williams:
  Elementary Mineralogy, *twice weekly, second half-year.*

Six numbers of the AMERICAN CHEMICAL JOURNAL have appeared within the year. These are Nos. 3, 4, 5, 6 of Vol. VI., and Nos. 1 and 2 of Vol. VII.

MINERALOGY AND PETROGRAPHY.

PROGRAMME FOR 1885-86.

In addition to the elementary instruction in Mineralogy included in the regular chemical courses (*above*), DR. WILLIAMS will give, during the first half-year, to advanced students a course on the *Mineralogy of the Silicates* with especial reference to their paragenesis and geological importance.

Particular attention will be devoted to the optical and microscopic characteristics of the rock-forming minerals as introductory to the lectures on *petrography* (both macroscopic and microscopic) which will form the subject of the latter portion of this course. These lectures are intended to be supplementary to the course on General Mineralogy given during the second half of the present year and only such students will be admitted to it as possess the necessary knowledge of crystallography and physical mineralogy.

During the second half-year lectures will be given to graduate students on General Mineralogy and the description of the non-silicate species. There will also be a certain number of lectures on Inorganic Geology.

Throughout the year opportunity will be afforded for special laboratory work in crystallography, physical mineralogy, and microscopical petrography. During the autumn and spring, as long as the weather permits, there will be weekly excursions in the neighboring country for the purpose of studying mineralogy and geology in the field.

WORK OF THE PAST YEAR, 1884-85.

Courses of lectures have been given by Dr. G. H. Williams on:

Inorganic Geology, Petrography, and General Mineralogy. *Three times weekly.*

Daily laboratory instruction has also been given in microscopical petrography and physical mineralogy.

Frequent excursions have been made and considerable material for a geological map of the vicinity of Baltimore has been brought together; much information as to the number and range of the minerals occurring within this district has also been collected.

Special and detailed microscopic studies have been made of the basic massive rocks (hypersthene- and olivine-gabbros and peridotites) occurring near Baltimore, as well as of the molecular and chemical changes which these have undergone.

Considerable microscopic work has also been done on the interesting massive rocks occuring near Peekskill, N. Y., which have been called by Prof. J. D. Dana the "Cortlandt Series."

BIOLOGY.

PROGRAMME FOR 188-86.

I. Collegiate Instruction.

This is designed especially for undergraduate students, but graduate students who have not had a thorough preliminary training will be required to follow the instruction in those subjects of the college course in which they are found to be deficient, before they will be permitted to undertake advanced biological studies or engage in original research.

The regular course of biological instruction extends over two years, but those who take Biology only as a subsidiary subject for the B. A. degree are not required to do more than the first year's work.

First Year (Minor) Course.

This has been planned to meet the needs (1) of those who intend ultimately to take up some one branch of Biology (Zoölogy, Physiology, or Botany) for special study; (2) of students, graduate or undergraduate, who expect later to study medicine, but meanwhile desire, as a valuable preparation, to obtain some general knowledge of the phenomena, laws, and conditions of life; (3) of those who desire, as a part of their general college training, some acquaintance with [illegible] methods of modern experimental and observational science, and select Biology as a subject of study with that end in view.

The course consists of five lectures or recitations weekly throughout the academic year, with laboratory work. The laboratory work takes the place of the greater part of the outside reading required in connection with most other undergraduate courses in the university. The following subjects are included in the year's work.

1. General Biology.

   Three lectures or recitations weekly from the commencement of the session until the end of March.

   Attention is directed to the broad characteristic phenomena of life and living things rather than to the minutiæ of descriptive Botany or Zoölogy, or to the characters of orders, genera, and species. In the laboratory the student learns how to observe, how to verify and describe what he observes, how to dissect, and how to use a microscope; he examines selected vegetable and animal types from unicellular organisms, such as the yeast-plant and Amœba, to the fern and the flowering-plant on one side and the crayfish and a mammal on the other. In the lecture room attention is mainly given to the fundamental biological facts and laws which the particular plant or animal under consideration is fitted to illustrate, the object being rather to give the student an idea of what is meant by the terms living thing, plant, animal, tissue differentiation, life history, organ, function, etc., than to teach him the elements of Botany and Comparative Anatomy as commonly understood. The organisms studied are Torula, Protococcus, Amœba, Micrococcus, Bacterium, Bacillus, Spirillum, Penicillium, Mucor, Spirogyra, Nitella, a moss, a fern, a flowering-plant, Infusoria, Hydra, starfish, earthworm, crayfish, clam, frog, terrapin, pigeon, and rat; so that at the close of the course the student has a practical knowledge of the structure and life conditions of a typical example from each of the main divisions of plants and animals, on which to base his reading and later studies.

2. The Embryology of the Chick and Mammal.

   Three lectures or recitations weekly from the beginning of April until the close of the session, with practical study of the development of a bird.

   In this course the student, who has already in his General Biology observed the natural arrangement of animals and plants in diverging series advancing from a simple bit of living matter to highly complicated organisms, studies the individual development of one of the higher animals, from its start as an almost formless bit of protoplasm to its final highly complex structure. The increasing differentiation of tissues and organs which he has noted as higher and higher plants and animals were dissected, he now sees exemplified by the chick embryo in different stages of development. At the same time a good foundation is laid for subsequent advanced study in Vertebrate Morphology.

3. Osteology, Human and Comparative.

   Two lectures or recitations weekly until the end of March, with practical study on selected skeletons.

   The student begins with the human skeleton, which, as the most minutely and accurately described of all conveniently accessible animal structures, is well fitted to train him to observe closely and accurately. He then studies a skeleton from each of the chief orders of the Mammalia and two or three from each of the remaining main groups of Vertebrata.

4. Plant Analysis and the elements of Systematic Botany.

   Practical instruction twice weekly from the beginning of April until the close of the session.

   The student is taught how to collect and preserve plants; and by the analysis of a number of flowering plants under the direction of his teacher, gets a good introduction to the terminology of descriptive botany, and learns how to use a botanical key for the recognition of species.

Second Year (Major) Course.

This is designed for those who, having completed the above minor course, desire to proceed farther with biological studies. Ultimately the second year's work in biology will be, at the choice of the student, one of three courses; in the first of these Animal Physiology will be the dominant study; in the second, Animal Morphology; in the third, Botany; for the present a choice is offered only between the first and second of the three.

[To complete a major course a student must, after finishing his minor, take either 1, 2, and 3, of the subjects below named, or 2, 3, and 4. The former combination is recommended to those who intend afterwards to study medicine].

1. Mammalian Anatomy.

   Twice weekly, until Christmas.

   In connection with this course the student dissects one of the higher mammals with all the minuteness with which the human body is dissected in a medical school. He thus not merely learns how to dissect thoroughly, but acquires a knowledge of the names, general distribution and structure of nearly all the muscles, nerves, vessels, and viscera, and becomes fitted to take up profitably the professional study of the details of descriptive and regional Human Anatomy, and so saves much time when he subsequently takes up more strictly professional studies.

2. Animal Physiology and Histology.

   Three lectures or recitations weekly during the year.

   This course is designed to give the student a good knowledge of the properties and mode of working in health of the various tissues and organs of the higher animals, man included; also to give him a good knowledge of their microscopic structure. It thus prepares the student for subsequent study of Pathology. In the laboratory each student examines for himself the histology of each organ and tissue, and thus learns the use of reagents and embedding materials, the methods of cutting and mounting sections, etc.; he also studies practically the composition of the more important organs and tissues, the chemistry of digestion, the fundamental properties of living muscles and nerves, the beat of the heart, the phenomena of reflex action, etc. Important physiological facts, which require special skill for their exhibition or the employment of especially delicate instruments, are demonstrated to the class. There will be, as a rule, one such demonstration weekly. No painful experiments are performed in connection with this course.

The physiological apparatus belonging to the University is unusually good and complete; students have, accordingly, not only the opportunity to acquire a knowledge of the methods of modern histological investigation, but also of the mode of using all the chief instruments employed in physiological, pathological, and pharmacological research.

3. Elements of Zoölogy.

Two lectures or recitations weekly from the Christmas recess until the end of the academic year.

A systematic course of lectures on the structure, relationships, and classification of animals. In the laboratory the student will dissect a number of forms selected to supplement the types studied in the General Biology course.

These types are—

Calcareous sponge; tubularian hydroid; hydro-medusa; actinia; starfish and its development; sea urchin and its development; holothurian; polychaetous annelid; leech; distoma; copepod; barnacle; crab, and its metamorphosis; limulus; scorpion; grasshopper; gasteropod; cephalopod; lingula; ascidian; amphioxus; shark; teleost; lizard.

4. Marine Laboratory.

At least two months' study at the marine laboratory of the University between June 1st and August 31st.

This may be taken in one year or a month may be taken in each of two consecutive years.

II. University Instruction and Opportunities.

This is designed for graduates who have already such knowledge of Biology as might be obtained by following the collegiate major course in that subject, and for others who, although not graduates, satisfy the university authorities that they are competent to undertake advanced work. In the university courses but little of the teaching is given by formal lectures; the instructors come into close daily contact with the students, supervise their work, direct their researches, and advise as to their reading.

1. Animal Physiology.

The new biological laboratory has been especially constructed with reference to providing opportunity for advanced work in experimental physiology. The collection of physiological instruments belonging to the University is unusually large and complete and is yearly added to,—the Trustees providing an annual sum for the purchase of instruments wanted for any particular investigation, or which for other reasons it is desirable to have in the laboratory. There is also a workshop in the laboratory in which a skilled mechanic is kept employed repairing and constructing instruments. The laboratory contains two large rooms for general advanced work in animal physiology, in addition to others specially designed for work with the spectroscope, with the myograph, for electro-physiological researches, and for chemical physiology.

2. Animal Histology.

The laboratory contains a special room constructed for advanced histological work, and well supplied with apparatus and reagents. There is also a room and apparatus for micro-photography.

3. Animal Morphology.

Rooms for advanced work in this subject are contained in the laboratory and a course of advanced lectures is given by Dr. Brooks. The chief advanced study in animal morphology is however carried on at the Marine Laboratory, open at the sea-side from the beginning of June until the end of August, under the direction of Dr. Brooks. The Marine Laboratory possesses a steam launch and a large sloop, and is supplied with dredges, boats, aquaria, microscopes, etc.

4. Physiological Psychology.

During the academic year a course of lectures, combined with laboratory work, will be given by Dr. G. Stanley Hall, in connection with the psychological courses of instruction in the university.

5. Lectures.

Dr. W. H. Howell will give about thirty advanced lectures on the Physiology of Respiration. Short courses of lectures will be given from time to time on other selected physiological and morphological subjects.

6. Journal Club.

A Journal Club, composed of the instructors and advanced students, meets weekly for the reading and discussion of recent biological publications.

7. Reading Clubs, in Animal Morphology and Physiology, for the study and discussion of classical biological works, meet weekly, during the greater part of the session.

8. Library Facilities.

The laboratory contains a library supplied with standard biological works and complete sets of the more important journals. There is also a special collection of books which have been brought together in connection with researches carried on in the laboratory. An effort is always made to procure for anyone engaged in a particular investigation all publications bearing on his work but not easily accessible, as gradua[illegible]n theses, occasional publications from laboratories in Europe and elsewhere, etc. The biological library receives regularly about forty biological periodicals, including all the important physiological and morphological journals in English, French, German, and Italian.

The general library of the University receives all the chief journals of general science, and the transactions of all the leading learned societies of the world.

The Library of the Peabody Institute, within five minutes' walk of the University, contains complete sets of many of the chief biological journals, of the proceedings of learned societies, and other works of reference.

In the library of the Medical and Chirurgical Faculty of Maryland, a very large number of medical periodicals is accessible to members of the University.

The proximity of Washington is of special value to advanced students of physiology. The Library of the Army Medical Museum in that city contains an almost unrivalled store of physiological works which are available under conditions favorable to study.

9. Publication.

In connection with the biological laboratory there is published a journal (*Studies from the Biological Laboratory*) which contains the results of most of the researches carried out in the laboratory; a ready means of publication for original work is thus secured. The *University Circulars*, which appear at short intervals throughout the year, are available for preliminary statements, securing priority for discoveries while more detailed accounts are in course of publication.

III. Naturalists' Field Club.

This was organized by members of the University, but includes in its list of members other residents of Baltimore interested in Natural History. The club works in three sections—Geology and Mineralogy, Zoölogy, Botany. Each section elects its own officers and arranges for its own field excursions and its own meetings. There are also monthly meetings of the whole club, when the chairmen of the different sections report progress and an address on some topic of Natural History is given by one of the members.

The mineralogical collections of the club are preserved in the Chemical Laboratory; the botanical and zoölogical in the Museum of the Biological Laboratory.

WORK OF THE PAST YEAR, 1884-85.

I. Laboratory Work.

The Biological Laboratory has been open for eight hours daily during the year, for the prosecution of advanced study and research and for courses of practical instruction in connection with class lectures.

During the year original investigations have been made in regard to the following subjects:

The proteids of blood plasma. The influence of intermittent pressure on arterial tonicity. The influence of various salts on arterial tonicity. The absolute relative value of commercial disinfectants and germicides. Regeneration of tissue in larvæ. The rate of propagation of the wave of muscular contraction. The proximate cause of the coagulation of blood. The functions of the cardiac nerves of the Chelonia. The nature of apnœa. The embryology of Echinoderms. The conditions which determine sex. The embryology of insects. The segmentation of the Vertebrate skull. The homology of the hypoglossus nerve.

Preliminary notices of the results of most of the above researches have already been printed in the *University Circulars*, in the *Zoologischer Anzeiger* and elsewhere. Fuller accounts will shortly be published.

In connection with the regular class instruction, first year students studied a number of typical fungi, green plants, and animals; the skeletons of about twenty selected vertebrates; and the development of the chick in the egg. In the spring there were twelve practical lessons in the elements of Systematic and Descriptive Botany.

Second year students worked at the histology of the tissues and organs of the higher vertebrata (especially man); the physiological properties and functions of the tissues and organs; the physiology of digestion; the chemistry of bile, urine, etc. The cat was thoroughly dissected by the second year students, and about twenty-five selected invertebrate and vertebrate types.

II. Advanced Instruction.

Dr. W. K. Brooks lectured twice weekly through the year on Advanced Morphology.

A course of seven lectures on Morphological Problems was given during April and May, as follows:

Three lectures by Mr. E. A. Andrews on the Anatomy, Embryology, and Affinities of Annelids.

One lecture by Mr. J. Playfair McMurrich on the Morphological Significance of the Hypoglossus Nerve.

One lecture by Mr. A. T. Bruce on the Embryology of Insects.

One lecture by Mr. Otto Lugger on Galls.

One lecture by Dr. W. K. Brooks on Alternation of Generations.

A course of six lectures on Animal Teratology was given by Dr. W. T. Councilman during May.

Most of the advanced work was carried on individually, and not in class; each worker taking up some special topic for study under the immediate direction of some one of the instructors. In addition to the original researches already enumerated, certain graduate students have in this manner carried on advanced study in various directions.

Students engaged in this kind of study (which forms a stepping-stone between class-work and original research), are usually given some important original article, and shown how to repeat and verify for themselves (and criticise) the experiments and results described in it. By studying and repeating the original work of others they learn the methods of biological investigation, and are thus trained to plan and carry out researches themselves. In connection with this work, students are also taught how to hunt up and utilize the bibliography of a subject.

III. Class Instruction.

Courses of lectures for undergraduates were given as follows:

Osteology, *twice weekly, until the end of March.*
Mammalian Anatomy, *twice weekly, until Christmas.*
Animal Physiology and Histology, *three times weekly, through the year.*
General Biology, *three times weekly, until the end of March.*
Embryology of the Chick and Mammal, *three times weekly, from the first of April until the close of the session.*
Plant Analysis, *twice weekly, in April and May.*

IV. Marine Laboratory.

During the summer of 1884, the seaside Zoölogical Laboratory for the study of forms of marine life, was open at Beaufort, N. C., for fifteen weeks.

The advanced work included original investigations on the following subjects:

The embryology and systematic zoölogy of Echinoderms, Annelids, and Medusæ. The susceptibility of marine animals to vegetable poisons. Digestion in the Anthozoa. The structure and affinities of Balanoglossus. The embryology of Gasteropod and the homology of the Gasteropod Gill. The early developmental stages of Teleostei. The origin and significance of alternation of generations in Hydroids. The segmentation of the vertebrate skull. The metamorphosis and systematic Zoölogy of the Stomatopods.

The results of many of these investigations have been already published; others will be shortly.

V. Publications.

Number 2 of the third volume of "*Studies from the Biological Laboratory*" was published in December. It contains:

I. Notes on the Composition of the Blood and Lymph of the Slider Terrapin (*Pseudemys rugosa*). By W. H. Howell.
II. The Origin of the Fibrin formed in the Coagulation of Blood. By W. H. Howell.
III. On the Action of Carbolic Acid, Atropia, and Convallaria on the Heart; with some Observations on the Influence of Oxygenated and Non-oxygenated Blood, and of Blood in various Degrees of Dilution. By H. G. Beyer. With Plate VII.
IV. The Action of Intermittent Pressure and of Defibrinated Blood upon the Bloodvessels of the Frog and the Terrapin. By L. T. Stevens and F. S. Lee.

Number 3, now in press, contains:

I. Marine Larvæ and their relation to adults. By H. W. Conn.
II. The cranial nerves of *Amia Calva.* By J. P. McMurrich.
III. The endings of the motor nerve fibres in the striped muscles of the Frog. By Christian Sihler.

Number 4, to be published in a few weeks, will contain:

I. Observations on Zoögloeæ and several related forms. By Wm. Trelease.

ANCIENT AND MODERN LANGUAGES.

PROGRAMMES FOR 1885-86.

GREEK.

I. Greek Seminary.

Professor Gildersleeve will conduct the Greek Seminary, the plan of which is based on the continuous study of some leading author or some special department of literature.

The Seminary consists of the director, fellows, and scholars, and such advanced students as shall satisfy the director of their fitness for an active participation in the work, by an essay, a critical exercise, or some similar test of attainments and capacity. All graduate students, however, may have the privilege of attending the course.

During the next academic year *the study of Plato and of the literary form of Greek Philosophy* will constitute the chief occupation of the members.

In connection with the Seminary the director will interpret the *Symposion* of Plato once a week with conferences on topics suggested by the text, of which Jahn's edition will be used.

The philosophy of Plato will also be taken up in the courses of Professor Hall.

It is important that all should be provided in advance with Ritter and Preller's *Historia philosophiae ex fontium locis contexta* with a complete Platonic text, and annotated editions of some of the principal dialogues, such as Hug's *Symposion*, Deuschle and Cron's or Sauppe's *Protagoras*, Deuschle and Cron's *Gorgias*, Wagner's *Phaidon*, Thompson's *Phaidros*, Riddell's *Apology*, and Campbell's *Theaitetos*.

II. Advanced and Graduate Courses.

1. **Professor Gildersleeve** will also conduct a course of *Practical Exercises in Greek*, consisting chiefly in translation at dictation from Greek into English and English into Greek, two meetings a week from the beginning of the session to the first of January.

2. He will give a course of lectures on *Greek Syntax:* (I) On the Hypotactic sentence; (II) On the influence of grammar on style. (This second part will comprise readings in Homer, Hesiod, the Dramatic Poets, Herodotos, and Thukydides). Once a week until the first of January, thenceforward twice a week.

III. Undergraduate Courses.

1. Xenophon, *Oeconomicus.*
   Four hours weekly, first half-year. **Dr. Spieker.**
   Private Reading: Lysias, *Orations* 7, 9, 12, 13, 24.
2. Homer, *Iliad*, 8, 9; Euripides, *Alcestis.*
   Four hours weekly, second half-year. **Dr. Spieker.**
   Private Reading: Herodotus, *Keep's Selections.*
3. Demosthenes, *De Corona.*
   Four hours weekly, first half-year. **Professor Morris.**
   Private Reading: Plato, *Protagoras.*
4. Sophocles, *Antigone*; Aristophanes, *Nubes.*
   Four hours weekly, second half-year. **Professor Morris.**
   Private Reading: Aeschylus, *Prometheus Vinctus.*
5. Prose Composition.
   Weekly exercises in connection with each of the above courses.
6. Conferences on Greek Literature.
   A series of conferences with illustrations from authors actually studied in the undergraduate department. Once a week, after the spring recess. **Professor Gildersleeve.**

LATIN.

I. Latin Seminary.

Dr. Warren will conduct the Latin Seminary. The *Latin Historians*, more especially *Livy* and *Tacitus*, will form the centre of work during the next academic year. There will be two meetings a week during the entire session, devoted to the critical interpretation of the authors above named, to auxiliary studies, and the presentation of papers by members of the Seminary. It is probable that during the first half of the year more particular attention will be paid to Livy, and in the latter half to Tacitus.

Students are advised to read in advance as much as possible of Livy and Tacitus, and to provide themselves with complete texts of Cæsar, Sallust, Livy (either Weissenborn, or Madvig and Ussing), Tacitus (Halm), and Suetonius (Roth).

II. Advanced and Graduate Courses.

1. During the first half of the year **Dr. Warren** will give a course of lectures on the *Roman Historians*, beginning with the earliest period.

2. In the latter half of the year, he will give a course of twenty lectures on *Historical Latin Grammar*, with especial reference to phonetic laws and the genesis of forms.

3. In the first half of the year, he will conduct a course of weekly meetings for the *Translation at Sight* of various Latin writers.

4. In the latter half of the year, there will be a course of *Practical Exercises in Latin*, one meeting a week, devoted mainly to translation at dictation from Latin into English, and from English into Latin.

III. Undergraduate Courses.

1. Livy, *two books.*
   Four hours weekly, first half-year. **Dr. Spieker.**
   Private Reading: Cicero, *pro Roscio Amerino, de Senectute, de Amicitia.*
2. Horace, *Select Odes, Satires and Epistles.*
   Four hours weekly, second half-year. **Dr. Spieker.**
   Private Reading: Horace, *Epodes and Carmen Saeculare;* Vergil, *Aeneid, book xii.*
3. Cicero, *de Natura Deorum, book i;* Lucretius, *books i and iii.*
   Seven hours in two weeks, first half-year. **Professor Morris.**
   Reading at sight.
   One hour every two weeks.
   Private Reading: Cicero, *de Natura Deorum, book iii;* Lucretius, *book v.*
4. Tacitus, *Agricola, Germania, Annales, books i and ii.*
   Four hours weekly, second half-year. **Professor Morris.**

Private Reading: Cæsar, *Bellum Civile, books i and ii;* Tacitus, *Annales, book iii.*

5. Terence, *Andria;* Plautus, *Miles Gloriosus.*
   Three hours weekly, first half-year. DR. WARREN.
   Reading at sight.
   One hour weekly.
   Private Reading: Plautus, *Mostellaria;* Terence, *Phormio.*
6. Pliny, *Letters;* Juvenal, *Select Satires.*
   Three hours weekly, second half-year. DR. WARREN.
   Reading at sight.
   One hour weekly.
   Private Reading: Cicero, *Select Letters.*
7. Prose Composition.
   Weekly exercises in connection with each of the above courses.

First year students must take courses 1, 2, and 7; second year students must take courses 3, 4, and 7, or 5, 6, and 7. Should a student be unable to do the Private Reading in connection with his class-work, he may take the examination in Private Reading or extra courses of class-work in a subsequent year.

SHEMITIC LANGUAGES.

PROFESSOR HAUPT will give the following courses:

1. Hebrew: Critical interpretation of the Minor Prophets.
   Wednesday, 3 p. m., during the first half-year.
   Liber duodecim prophetarum, ed. Baer, Lipsiae, Tauchnitz.
2. Hebrew: Critical interpretation of the Book of Proverbs.
   Wednesday, 3 p. m., during the second half-year.
   Liber Proverbiorum, ed. Baer, Lipsiae, Tauchnitz.
3. Hebrew Exercises: Reading historical books at sight.
   Wednesday, 4 p. m.
4. Biblical Aramaean: Interpretation of the Chaldee portions of the book of Ezra.
   Tuesday, 3 p. m.
   Libri Danielis, Ezrae et Nehemiae, ed. Baer, Lipsiae, 1882; Kautzsch, *Grammatik des Biblisch-Aramäischen*, Leipzig, 1884.
5. Syriac for beginners: Elements of the grammar and reading of the Syriac version of the Bible and the Syriac Chronicles of Bar Ebrâyâ.
   Tuesday, 4 p. m.
   E. Nestle, *Brevis linguae Syriacae grammatica*, Carolsruhae et Lipsiae, 1881; Theodor Nöldeke, *Kurzgefasste Syrische Grammatik*, Leipzig, 1880; Aemilius Roediger, *Chrestomathia Syriaca*, Halis Saxonum (third edition in preparation).
6. Ethiopic: Interpretation of the Prayers, Sermons and Homilies in Dillmann's Chrestomathia Aethiopica, Lipsiae, 1868.
   Wednesday, 10 a. m.
7. Arabic: Reading of selected portions of the Arabian Nights and extracts from Arabic geographical writers.
   Wednesday, 11 a. m., during the first half-year.
   Beyrut Arabic Chrestomathy *Majâni el-adab*, Beyrut, 1883, Imprimerie Catholique; *Vocabulaire Arabe-Français* à l'usage des étudiants par un père missionnaire de la Compagnie de Jésus, Beyrouth, Imprimerie Catholique, 1883.
8. Arabic Syntax and Reading of selected sûras of the Corân.
   Wednesday, 11 a. m., during the second half-year.
   Sir William Muir, *Extracts from the Coran in the original*, London, 1880; Dieterici, *Arabisch-Deutsches Handwörterbuch zum Koran*, Leipzig, 1881; Penrice, *Dictionary of the Koran*, London, 1873. William Wright, *A Grammar of the Arabic Language*, 2d edition, London, 1874.
9. Assyrian: Interpretation of the Annals of Sennacherib (I R., 37–40):
   Thursday, 10 a. m., during the first half-year.
   Sir Henry Rawlinson, *The Cuneiform Inscriptions of Western Asia*, Vol. I, London, 1861.
10. Interpretation of selected portions of the Nimrod Epic with the cuneiform account of the Deluge and the Creation Tablets.
    Thursday, 10 a. m., during the second half-year.
    Haupt, *Das babylonische Nimrodepos*, Leipzig, 1884; Delitzsch, *Assyrische Lesestücke*, third edition (in preparation), Leipzig, 1885.
11. Babylonian: Introduction to the study of Babylonian texts and interpretation of the inscriptions of Nebuchadnezzar, Neriglissar, Nabonidus, etc., the Cylinders of Cyrus and Antiochus (V R., 35 and 66), Babylonian Letters and Despatches, Observatory Reports, Contract Tablets, etc., etc.
    Thursday, 3 p. m.
    Sir Henry Rawlinson, *The Cuneiform Inscriptions of Western Asia*, Vols. I and V, London, 1861 and 1884; Theo. G. Pinches, *Texts in the Babylonian Wedge-Writing*, London, 1882 (Society of Biblical Archæology).
12. Akkadian: Reading of selected grammatical texts.
    Haupt, *Keilschrifttexte*, Part II, Leipzig, 1880; *Cuneiform Inscriptions of Western Asia*, Vol. V.
13. Sumerian: Interpretation of selected bilingual hymns and penitential psalms.
    Haupt, *Keilschrifttexte*, Part III, Leipzig, 1880; Sir Henry Rawlinson, *Cuneiform Inscriptions of Western Asia*, Vol. IV, new edition (in preparation), London, 1885.

It is expected that courses for beginners in Hebrew, Arabic, and Assyrian (should there be any demand for them), will be given under the supervision of Professor Haupt, by Mr. Adler and Mr. Huizinga, as Fellows in Shemitic Languages.

SANSKRIT AND THE COMPARATIVE GRAMMAR OF THE COGNATE LANGUAGES.

DR. BLOOMFIELD will give the following courses:

1. Sanskrit. (*First year*).
   Whitney's grammar and the selections from the *Nala* and *Hitopadeça* in Lanman's reader. *Twice a week.*
2. Sanskrit. (*Second year*).
   a. Selections from the *Kathâsaritsāgara* and the *Mānava-dharmaçâstra.*
   b. Introduction into the *Rig-Veda.* *Twice a week.*
3. Sanskrit. (*Advanced course*).
   Hymns of the *Atharva Veda*, accompanied by the corresponding passages of its sūtra, the *Kauçika*, and its commentary (*Dārila*). *Weekly, through the year.*
4. General principles of Comparative Philology.
   Lectures and Whitney's "Language and the Study of Language." *Weekly, through the year.*
5. Comparative Greek Grammar.
   A cursory survey based on Gustav Meyer's Griechische Grammatik.
6. The formation and syntax of Indo-European Noun-Compounds.
   Ten lectures with special reference to the classical and Teutonic languages and Sanskrit.

GERMAN.

I. Advanced Courses.

Advanced courses will be given by DR. WOOD as follows:

1. The German Seminary.
   Twice weekly, through the year.
   The work of the Seminary for the year will centre in Low German. An introduction on the language and literature of Low German will be given, including the outlines of Old Saxon grammar.

Part of the *Hêliand* (ninth century) will be read and explained. The editions of *Heyne* (3 Auflage, Paderborn, 1883), and *Sievers* (Halle, 1878), will be used. This will be followed by *Mittelniederdeutsch;* Lübben's *Grammatik und Chrestomathie* (Leipzig, 1882), and by *Lauremberg's Niederdeutsche Scherzgedichte* (seventeenth century) *ed. Braune* (Halle, 1879).

2. Modern Low German.
   Nerger's *Grammatik des Mecklenburgischen Dialektes*, Leipzig, 1869. *Weekly, second half-year.*
   An introduction to the dialect will be given, selections from *Groth* and *Reuter* read, and their position and influence in German literature explained.
3. Gothic.
   Twice weekly, first half-year.
   Braune's *Grammatik* (2 Auflage, 1884). Bernhardt, *Kurzgefasste Gotische Grammatik* (Halle, 1884).
4. Old Norse.
   Twice weekly, first half-year.
   Noreen, *Altisländische Grammatik* (Halle, 1884). Brenner, *Altnordisches Handbuch*, Leipzig, 1883.
5. Middle High German.
   Wolfrum von Eschenbach's *Perzival. Weekly, second half-year.*
6. Old Teutonic Life.
   Weekly, first half-year.
   Class lectures on Mythology and Folk Lore, Law, Domestic Life, Ships and the Sea, the Germanic hall and house, etc.

II. Undergraduate Courses.

Collegiate courses will be conducted as follows:

Minor (First Year) Course.

1. Classics.
   Three times weekly. Dr. Goebel and Mr. Hempl.
   Goethe: *Prosa, Egmont.* Schiller: *Maria Stuart.* Lessing: *Minna von Barnhelm.*
2. Historical Readings.
   Twice weekly. Dr. Goebel.
   Freytag: *Bilder aus der deutschen Vergangenheit III* (*Aus dem Jahrhundert des grossen Krieges*). Riehl: *Geschichten und Erzählungen I.*
   There will be a course of parallel readings, centering in the period of the Thirty Years' War.
3. Scientific Readings.
   Twice weekly. Mr. Hempl.
   Hodges' *Scientific German*, and Humboldt *in Auswahl.*
4. Prose Composition.
   Weekly. Mr. Hempl.
5. Oral Practice.
   Weekly. Mr. Hempl.
   Based upon readings and exercises.

Students may choose classes making up the Minor Course under the direction of the instructor. Thus a complete course may consist of Nos. 1, 4, 5, or 2, 4, 5, and one hour of 1, or of 3, 4, 5, and one hour of 1.

Major (Second Year) Course.

1. Classics.
   Twice weekly. Dr. Goebel.
   Goethe: *Hermann und Dorothea, Iphigenia, Faust, I;* Schiller: *Wallenstein.*
2. Middle High German.
   Weekly. Dr. Wood.
   Selections from the *Nibelungen Lied, Gudrun*, etc.; lectures on the chief Teutonic epic cycles, with illustrations.
3. Selected Readings.
   Masius's Lesebuch III. Weekly. Dr. Goebel.
   The selections are made from historical, scientific, and miscellaneous prose. Students may, with the advice of the instructor, choose between this course and the preceding.
4. Prose Composition.
   Weekly. Mr. Hempl.
5. German Literature.
   Weekly. Dr. Goebel.
   Lectures and Readings with Kluge's *Geschichte der deutschen Literatur.*
6. Exercises in German Style and Syntax.
   Monthly. Dr. Goebel.

Classes in German Conversation will meet daily through the year.

Supplementary Classes.

Section I. Otis's Elementary German; Whitney, Grammar and Reader. Twice and three times in alternate weeks. This class prepares undergraduates for entering the Minor Course. Mr. Hempl.

Section II. Otis, Elementary German; Whitney, Grammar; Goethe, Prosa; Schiller, Wilhelm Tell; Lessing, Minna von Barnhelm; Prose Composition. Daily, through the year. This class is in place of the regular German Minor Course for students who have passed the matriculation examination in Greek. It is also recommended for graduates beginning German. Mr. Hempl.

ENGLISH LANGUAGE AND LITERATURE.

I. Advanced Courses.

Dr. Bright will conduct advanced courses as follows:

1. Oldest English Texts. (Anglo-Saxon).
   Twice weekly, throughout the year.
2. Historical English Grammar.
   Twice weekly, throughout the year.
3. Teutonic Seminary.

II. Undergraduate Courses.

Minor (First Year) Course.

1. Elizabethan Writers.
   Twice weekly, first half-year. Dr. Browne.
2. Fourteenth Century Writers.
   Twice weekly, second half-year. Dr. Browne.
3. Eighteenth Century Writers.
   Once weekly, through the year. Dr. Browne.
4. Elements of Phonetics.
   Once weekly, first half-year. Dr. Bright.
5. History of English Language.
   Once weekly, second half-year. Dr. Bright.
6. Elementary Anglo-Saxon.
   Once weekly, throughout the year. Mr. Egge.
7. Essays by Students.

Major (Second Year) Course.

1. Anglo-Saxon.
   Once weekly, throughout the year. Dr. Bright.
2. First English Literature (Ninth to Eleventh Centuries).
   Once weekly, throughout the year. Dr. Bright.
3. Early English (Twelfth and Thirteenth Centuries).
   Twice weekly, throughout the year. Mr. Egge.

4. Modern English Literature.
Once weekly, through the year. Dr. Browne.

5. Essays by Students.

English required of all undergraduates.

Synoptical study of English Literature (in P. H. E. Course).
Twice weekly, through the year. Dr. Browne.

Summary of English Courses.

Advanced Courses. These courses are intended to meet the requirements of those who are aiming at special scholarship in English. Methods are employed by which the labors of past and contemporary scholars are made available, and by which the student may be led to individual research.

Anglo-Saxon and Middle English. The student will at once begin the grammatical study of the oldest period of English, and in the first year will be required to do the work represented by Sweet's *Anglo-Saxon Reader.* The next year he will pass to the more exact study of the leading Anglo-Saxon dialect (West-Saxon), using Sievers' *Old English Grammar,* edited by Prof. Cook, and reading a good portion of the best West-Saxon prose (such as Sweet's ed. of Alfred's *Orosius*); some of the minor poems (Wülker's *Kleinere Angelsächs. Dichtungen*); and later Anglo-Saxon miscellaneous prose (*Homilies,* etc.). The Grammar will be supplemented by constant regard to the subsequent development of the language in forms and syntax. The course in English of the twelfth and thirteenth centuries, carried on simultaneously, will connect organically with Anglo-Saxon on the one side, and with the language of Chaucer on the other.

Elements of Phonetics. In accordance with the doctrine that growth and changes in language rest upon the two-fold basis of physical and psychical laws, and that mental analogies only occasion phonetic possibilities, the elements of the science of the physical production of speech are introduced at the beginning of this course, where the student's own vernacular can be employed in direct practical application of the principles involved. The student will be taught to realize in practice the phonetic categories of language, and thus to arrive at a living definition of the terminology of the grammarian. Observation in this field will be restricted, primarily, to his own pronunciation, and to the various phases of his own language, and secondarily, to the next best known phenomena of German and French. A foundation will thus be laid for the more exact methods in the subsequent work of the course in Modern Languages.

History of the English Language. The outlines of this subject are imparted by means of text-books, supplementary lectures, and "private readings." The aim is to enforce in a clear and orderly manner a sense of the historic continuity of the English Language.

First English Literature. The literature of the Anglo-Saxon period will be studied upon the basis of the treatise of ten Brink, amplified by the results of modern investigation and criticism.

English Literature. It will be seen that in the literary part of these courses the same idea of continuity prevails that is emphasized in the linguistic part. The student is first given a synoptical view of the whole field. In the major and minor courses the most important periods of literary production are studied, from the ninth century to the nineteenth. From the fourteenth century down, the history, manners, political and religious conditions, etc., of the people, are explained sufficiently to indicate the position of the chief writers of each period, and the influences under which they wrote.

For the fourteenth century, the central work will be in Chaucer and Langland; for the Elizabethan period, in Shakespeare; for the eighteenth, in Pope and the Essayists.

The essays required of students are intended to promote the attainment of a good English style. The instructor is thus enabled to see the defects of each writer, and to give him the help and counsel that he needs, instead of laying down general principles from the lecturer's desk.

P. H. E. Course. The object of the English portion of the required course in Physical Geography, History, and English, is to present a view of English Literature as a whole, preparatory to more critical study. Stopford Brooke's *Primer of English Literature* is recommended for reference. The books necessary for reading in class will be announced by the instructor.

ROMANCE LANGUAGES.

I. Undergraduate Courses.

A class for beginners will meet daily through the year. The text-books used will be Chardenal's First and Second French Course, together with Breymann's French Grammar. The course does not count as part of the requirements for graduation, but is simply an aid provided by the university for those who are not ready to enter class A, for which the work here done is considered a sufficient preparation.

French: Class A.

(Course (minor) for a first year).

To enter this course both a written and an oral examination must be passed. Candidates will be required to have a thorough knowledge of Grammar forms, especially of the irregular verbs, to have read one hundred duodecimo pages of French Prose, and to have translated twenty-five pages of English exercises into French. For oral examination they are requested to offer the texts they have used in preparation. The work here will consist in the following readings, all of which must be taken by students who select the course.

1. Literary.
Selections from Alfred de Musset, Théophile Gautier, Edmond About, Alphonse Daudet, and Francois Coppée (O'Connor: *Choix de Contes Contemporains*). Fiévée: *La Dot de Suzette,* (Masson: French Classics, Vol. V.). Victor Hugo: *Hernani,* (Theatre Français du XIX Siècle). *Twice weekly.* Dr. Todd.

2. Historical.
Crane and Brun: *Tableaux de la Révolution Française.* Gérusez: *La Littérature Française pendant la Révolution.* *Weekly.*

3. Scientific.
Flammarion: *Merveilles du Ciel.* *Weekly.*

4. French Composition.
Syntax, *first half-year;* Idioms, *second half-year.* *Weekly.*

5. Lectures. (Modern Literature).
Bougeault's *Précis historique et chronologique de la Littérature Française* will be used as the basis for twenty-minute lectures in connection with the Literary Course. Dr. Todd.

Opportunity for thorough training in French pronunciation and conversation will be given, a special class meeting for this purpose one hour daily throughout the year.

French: Class B.

(Course (major) for a second year).

Open only to those who have pursued the first year's course or its equivalent.

1. Classical French.
Corneille: *Cinna, Le Menteur;* Racine: *Andromaque, Athalie;* Molière: *Les Femmes Savantes, Les Fourberies de Scapin;* Blouet: *L'Eloquence de la Chaire et de la Tribune françaises.* *Weekly.* Dr. Todd.

2. Sixteenth Century French.
Darmesteter et Hatzfeld: *Morceaux Choisis.* *Weekly, first half-year.* Dr. Todd.

3. Old French.
Bartsch: *Chrestomathie de l'Ancien Français.* *Weekly, second half-year.* Dr. Todd.

4. Prose Composition.

Gasc's Prose Composition, *first half-year;* Original Essays, *second half-year.* *Weekly.*

5. Lectures on Classical French Literature, *first half-year,* on Early French Literature, *second half-year.*

Weekly. Dr. Todd.

II. Special Courses in Italian and Spanish.

1. Italian. Dr. Todd.

(*a*) *Literary Course.* Massimo d'Azeglio: *Nicolò de' Lapi;* Alfieri: *Filippo;* Goldoni: *Gl' Innamorati;* Dante: *Inferno.* *Weekly.*

(*b*) *Historical Course.* Machiavelli: *Il Principe;* Sonzogno's *Storia della letteratura italiana.* *Weekly.*

(*c*) *Grammar and Composition.* *Weekly.*

2. Spanish. Dr. Todd.

Selections from "Fernan Caballero," José Selgas, Lafuente, Javier de Burgos, Juan Valera, Emilio Castelar. Knapp: *Spanish Grammar and Readings, first half-year.* Calderon: *El Mágico Prodigioso;* Cervantes: *Don Quijote; El Poema del Cid, second half-year.* *Twice weekly.*

III. Advanced Courses in Romance Philology.

The work in Romance Philology for properly qualified students extends through three years. It is intended primarily for Graduate Students and is specially adapted to the training of teachers and specialists. Students who enter for the later years of the course must show that they are acquainted with the subjects previously studied, and those who begin the course must show that they are familiar with Latin, Modern French and German.

Mr. Elliott will give the following courses:

1. With first year graduate students.

First Half-Year: (*a*) The reading of Old and Middle French, Old Provençal, Italian, Spanish and Portuguese texts.

For the French, Bartsch's *Chrestomathie de l'ancien Français* and Darmesteter et Hatzfeld's *Morceaux Choisis* will be used, for Old Provençal, Bartsch's *Chrestomathie Provençale.* *Weekly.*

(*b*) Lectures on Modern French Phonology.

Weekly.

Second Half-Year: The continuation of Old French and Provençal with the addition of

(*c*) Introduction to Old French Philology.

Aucassin et Nicolète (Suchier's edition). *Weekly.*

(*d*) Wallachian.

Weekly.

2. With second year graduate students.

(*a*) Old French Seminary (two hours); Lectures on Comparative Romance Morphology and Langue d'Oïl Dialects (original texts and practical exercises).

Weekly, through the year.

(*b*) The History of Romance Studies in Europe.

Weekly, first half-year.

3. With third year graduate students.

The Seminary work will centre here in the *Vie de Saint Alexis,* from which the student will pass to a study, for two hours weekly during the year, of the early Franco-Norman Dialect in its relations to the Anglo-Norman and to the Ile-de-France species.

First Half-Year: The Italian and Spanish Dialects and Old French Syntax.

An important feature of the former of these courses, will be the reading of original texts and the tracing of their phonetic and morphological relations to the Classic and Low Latin and to the leading literary types of to-day. For the Syntax, Old French is made the basis of work simply to have a convenient point of departure with which students have become more or less familiar in the first two years of their university training. Constant comparison is kept up from the beginning of the course with Latin word-relation and that of the earlier stages of the other leading Romance Languages. *Weekly.*

Second Half-Year: Romance Palæography and Low Latin.

The first course here will be carried out with fac-similes of French, Italian and Spanish MSS.; the second will also consist in the reading of texts as given in Paul Meyer's *Recueil d'anciens textes bas latins,* a critical examination of a part of the Probi appendix, as published in the same work, and of the Reichenau Glosses, as given in Förster and Koschwitz' *Altfranzösisches Übungsbuch.* *Weekly.*

WORK OF THE PAST YEAR, 1884-85.

Greek.

Under the direction of Professor Gildersleeve the advanced students of Greek have been organized into a Greek Seminary. According to the plan of the seminary, the work of each year is concentrated on some leading author or some special department of literature. During the past year the work has been in the Attic Orators.

In the seminary proper, which met twice a week during the academic year, the orators chiefly studied were Antiphon, Andokides, Lysias, Isaios, and Demosthenes. Especial attention was paid to the development of language and style and to the antique canons of aesthetic criticism. The members were required to furnish in turn exegetical and critical commentaries on select portions of the orators, to make analyses of speeches and abstracts of rhetorical treatises.

Of the investigations carried on may be noted: The phraseology and syntax of the fifth oration of Antiphon, the style of Andokides' third as compared with the first and second orations, Thrasymachos of Kalchedon, comparative study of the Trapezitikos and Aiginetikos of Isokrates, synonyms in the orators, the use of the participle in Greek lyric poetry, on the language of the oracles especially in Herodotos, special studies in the vocabulary of Dionysios.

The work of the seminary was supplemented by the study, with critical exercises, under the guidance of the Director, of the rhetorical works of Dionysios of Halikarnassos, and by a course of lectures on the History of Greek Oratory.

Besides the seminary course proper, Professor Gildersleeve delivered twenty-three lectures on Greek Syntax, conducted twenty-two exercises in translating at dictation from Greek into English and English into Greek, and gave a course of twenty lectures on Lyric Poetry. He also conducted a series of sixteen conferences in Greek Grammar for undergraduates.

Mr. Harris conducted class courses in New Testament Greek (three times weekly, first half-year, and five times weekly, second half-year), and in Sub-Apostolic Literature (three times weekly through the year); and gave a course of eight public lectures on the Perpetuation of Ancient Manuscripts.

Classes were conducted by Dr. Emerson in Classical Archæology (weekly through the year), in the Attic Judicial System (weekly, second half-year), and in the History of Ancient Art (twice weekly, second half-year).

Additional courses were conducted by:

Professor C. D. Morris, in

Plato, *Gorgias, four times weekly, first half-year.*

Aeschylus, *Persae;* Euripides, *Iphigenia in Tauris, three times weekly, second half-year.*

Reading at sight.

Dr. Spieker, in

Isocrates, I, IV; Xenophon, *Hiero, four times weekly, first half-year.*

Homer, *Iliad*, XVI–XVII; Euripides, *Hercules Furens, four times weekly, second half-year.*

Classes in Greek Prose Composition were also conducted by each of the instructors in connection with the courses above named.

Students have privately read for examination the following books:

Herodotus, *Merry's Selections*, (6).
Homer, *Odyssey*, XXI–XXIV, (6).
Xenophon, *Oeconomicus*, (7).
Plutarch, *Themistocles*, *Cicero*, (6).

Latin.

The Latin Seminary, under the direction of Dr. Warren, held two sessions a week throughout the year, the authors forming the centre of work being the Roman Satirists, especially Horace and Juvenal.

Some of the Fragments of Lucilius were read and discussed, select Satires of Horace and Juvenal were interpreted by the members of the Seminary, in turn, and papers were read by them embodying the results of special studies. Among the subjects thus treated were Juvenal's use of the gerund and gerundive; words borrowed from the Greek used by Horace and Juvenal; the use of the conjunction *cum* in Juvenal; the conditional sentence in Juvenal; the *sermo familiaris* as seen in Lucilius, Horace, Persius, Juvenal, and Petronius; the use of certain suffixes in Plautus, Terence, Lucilius, Horace, Persius, and Juvenal; the future active participle in Juvenal; the position of adjectives with respect to their substantives in Horace; the so-called Sulpiciae Satira; the use of the preposition *de* in Juvenal; the differences existing between the Satires and other works of Horace; some peculiarities of the Horatian Hexameter based upon statistics collected by members of the Seminary.

In connection with the Seminary work, Dr. Warren gave a course of weekly lectures during the first half of the year on the Roman Satirists. In the latter half of the year Dr. Warren conducted a weekly course of Practical Exercises in Latin.

Additional courses have been conducted during the year by:

Dr. Warren, in

Plautus, *Mostellaria*, and Terence, *Andria, three times weekly, first half-year.*
Tacitus, *Agricola*, *Germania*, *Annals*, I, *three times weekly, second half-year.*
Reading at sight, *weekly, throughout the year.*

Professor C. D. Morris, in

Cicero, *de Oratore* I, *Tusculan Disputations* I, *three times weekly, first half-year.*
Catullus and Martial, *Select Poems, three times weekly, second half-year.*
Reading at sight, *weekly, throughout the year.*

Dr. Spieker, in

Livy, II, III, *four times weekly, first half-year.*
Horace, *Select Odes, Satires, and Epistles, four times weekly, second half-year.*

Classes in Latin Prose Composition, meeting weekly, were also conducted by each of the instructors in connection with the courses above named.

Students have privately read for examination the following books:

Cæsar, *Bellum Civile*, (9).
Cicero, *de Senectute*, (1); *de Amicitia*, (9); *Tusculan Disputations*, II, (2); *Orator*, (2).
Horace, *Epodes*, *Carmen Saeculare*, (12).
Livy, V, VI, (1).
Ovid, *Fasti*, I, II, (12); *Selections*, (1).
Plautus, *Captivi*, (3).
Pliny, *Select Letters*, (2).
Tacitus, *Agricola*, *Germania*, (1); *Histories*, I, (1); *Annals*, III, IV, (6), IV, V, (1).
Terence, *Phormio*, (3).

Shemitic Languages.

The work of the past year was essentially a continuation of the courses begun during the session 1883–84. For beginners the only course given was in elementary Hebrew. The course in the elements of Biblical Aramacan presupposed a thorough knowledge of Hebrew. The Shemitic studies again centred in the Old Testament on which at first five, and later four, lectures a week were given.

In the *Hebrew course for beginners* the essential elements of the grammar were acquired (after Gesenius-Kautzsch's Hebrew Grammar, translated by E. C. Mitchell) and then the reading of the Pentateuch was entered upon.

In the *Hebrew Exercises* about forty chapters from the historical books of the Old Testament were read at sight: Exodus, 16; Genesis, 11 and 12; Jonah, 1 and 3; Job, 1 and 2; Exodus, 3 and 4; Judges, 19 and 20; 2 Samuel, 11; Numbers, 22; Judges, 11; 1 Kings, 17; Exodus, 31 and 32; 2 Kings, 19–21; Deuteronomy, 34, and Joshua, 1–2; Nehemiah, 1 and 2; Jeremiah, 37 and 38; 1 Samuel, 13; 1 Kings, 12 and 13; 1 Chronicles, 10, and 1 Samuel, 31, and 2 Samuel, 1; 2 Samuel, 12; Judges, 6; Ruth, 1 and 2; 1 Kings, 1 and 2; Nehemiah, 8 and 9.

In the *Critical Interpretation of Selected Psalms*, Psalms 23 and 1, and especially the fifteen post-exilic so-called Songs of degrees (Ps., 120–134) Hebrew *Shîrê hamma'alôth, i. e.*, the Songs of the Return (from exile) were thoroughly explained and critically analyzed, with special attention to textual criticism, date of authorship, and constant comparison with the ancient versions of the Psalter.

In the course in the *Elements of Biblical Aramaean* the forms were studied after the paradigm-tables in Baer and Delitzsch's edition of *Libri Danielis, Ezrae et Nehemiae* (Leipzig, 1882) and the first chapters of the book of Daniel read. This course was especially intended as a preparation for the study of Syriac.

In *Arabic* there was read the anecdote of a man of Baghdâd and his slave girl from the *Kitâb tazyîn el-aswâq* (Kosegarten's *Chrestomathia Arabica*, p. 22; Petermann, *Brevis linguae Arabicae grammatica*, p. 33; cf. Lane, *The Thousand and One Nights*, Vol. III, p. 524), and then extracts from the Travels of Ibn Baṭûṭah in the first volume of the Beyrut Arabic Chrestomathy *Majâni-el-adab* (Beyrut, 1883, Imprimerie Catholique): No. 302, The sheikh Abdallah and the elephants; No. 309, The wagons in the Crimean (*Qifjaq*) Steppes; No. 313, Ibn Baṭûṭah's journey to the city of Bolgary; No. 344, Ermine and Sable; No. 320, Meteorites, and finally No. 314, Ibn Baṭûṭah's journey to China and his suffering in captivity. In addition the class met two hours weekly to read easy Arabic texts at sight, under the guidance of Dr. A. L. Frothingham, Fellow in Shemitic Languages; selections from the Chronicles of Abulfaraj, Fables, Anecdotes, etc., were read.

In *Ethiopic* the whole book of Baruch in Dillmann's *Chrestomathia Aethiopica* was explained. This was preceded by a series of lectures on the grammar of the Geez language.

In *Assyrian* a course of lectures was first given on Comparative Assyrian Grammar, after which the cuneiform account of the campaign against the Arabians in the Annals of King Sardanapalus (B. C. 668–626) was studied. This was read and explained from beginning to end (V R. 7, 82–10, 5).

In *Sumero-Akkadian* the Syllabaries and Vocabularies in the first part of Haupt's *Keilschrifttexte* were finished, besides the Akkadian Incantation No. 9 and the Sumerian Penitential Psalms No. 14 in Haupt's *Texts*, and finally the Sumero-Akkadian Family Laws (V R., 24).

All the courses were one hour a week through the year with the exception of Elementary Hebrew, Ethiopic, and Assyrian, to which in turn two hours a week were devoted.

Sanskrit and Comparative Grammar of the Cognate Languages.

During the session the following courses were conducted by Dr. Bloomfield:

1. *Elementary Sanskrit.* The most essential elements of the grammar of the classical language were acquired in as short a time as possible, and then the students were brought face to face with the language, learning [illegible]

4. Prose Composition.
   Gasc's Prose Composition, *first half-year;* Original Essays, *second half-year. Weekly.*
5. Lectures on Classical French Literature, *first half-year,* on Early French Literature, *second half-year.*
   Weekly. Dr. Todd.

II. Special Courses in Italian and Spanish.

1. Italian. Dr. Todd.
   (*a*) *Literary Course.* Massimo d'Azeglio: *Nicolò de' Lapi;* Alfieri: *Filippo;* Goldoni: *Gl' Innamorati;* Dante: *Inferno. Weekly.*
   (*b*) *Historical Course.* Machiavelli: *Il Principe;* Sonzogno's *Storia della letteratura italiana. Weekly.*
   (*c*) *Grammar and Composition. Weekly.*
2. Spanish. Dr. Todd.
   Selections from "Fernan Caballero," José Selgas, Lafuente, Javier de Burgos, Juan Valera, Emilio Castelar. Knapp: *Spanish Grammar and Readings, first half-year.* Calderon: *El Mágico Prodigioso;* Cervantes: *Don Quijote; El Poema del Cid, second half-year. Twice weekly.*

III. Advanced Courses in Romance Philology.

The work in Romance Philology for properly qualified students extends through three years. It is intended primarily for Graduate Students and is specially adapted to the training of teachers and specialists. Students who enter for the later years of the course must show that they are acquainted with the subjects previously studied, and those who begin the course must show that they are familiar with Latin, Modern French and German.

Mr. Elliott will give the following courses:

1. With first year graduate students.
   First Half-Year: (*a*) The reading of Old and Middle French, Old Provençal, Italian, Spanish and Portuguese texts.
   For the French, Bartsch's *Chrestomathie de l'ancien Français* and Darmesteter et Hatzfeld's *Morceaux Choisis* will be used, for Old Provençal, Bartsch's *Chrestomathie Provençale. Weekly.*
   (*b*) Lectures on Modern French Phonology.
   Weekly.
   Second Half-Year: The continuation of Old French and Provençal with the addition of
   (*c*) Introduction to Old French Philology.
   Aucassin et Nicolète (Suchier's edition). *Weekly.*
   (*d*) Wallachian.
   Weekly.
2. With second year graduate students.
   (*a*) Old French Seminary (two hours); Lectures on Comparative Romance Morphology and Langue d'Oïl Dialects (original texts and practical exercises).
   Weekly, through the year.
   (*b*) The History of Romance Studies in Europe.
   Weekly, first half-year.
3. With third year graduate students.
   The Seminary work will centre here in the *Vie de Saint Alexis,* from which the student will pass to a study, for two hours weekly during the year, of the early Franco-Norman Dialect in its relations to the Anglo-Norman and to the Ile-de-France species.
   First Half-Year: The Italian and Spanish Dialects and Old French Syntax.
   An important feature of the former of these courses, will be the reading of original texts and the tracing of their phonetic and morphological relations to the Classic and Low Latin and to the leading literary types of to-day. For the Syntax, Old French is made the basis of work simply to have a convenient point of departure with which students have become more or less familiar in the first two years of their university training. Constant comparison is kept up from the beginning of the course with Latin word-relation and that of the earlier stages of the other leading Romance Languages. *Weekly.*
   Second Half-Year: Romance Palæography and Low Latin.
   The first course here will be carried out with fac-similes of French, Italian and Spanish MSS.; the second will also consist in the reading of texts as given in Paul Meyer's *Recueil d'anciens textes bas latins,* a critical examination of a part of the Probi appendix, as published in the same work, and of the Reichenau Glosses, as given in Förster and Koschwitz' *Altfranzösisches Übungsbuch. Weekly.*

WORK OF THE PAST YEAR, 1884-85.

Greek.

Under the direction of Professor Gildersleeve the advanced students of Greek have been organized into a Greek Seminary. According to the plan of the seminary, the work of each year is concentrated on some leading author or some special department of literature. During the past year the work has been in the Attic Orators.

In the seminary proper, which met twice a week during the academic year, the orators chiefly studied were Antiphon, Andokides, Lysias, Isaios, and Demosthenes. Especial attention was paid to the development of language and style and to the antique canons of aesthetic criticism. The members were required to furnish in turn exegetical and critical commentaries on select portions of the orators, to make analyses of speeches and abstracts of rhetorical treatises.

Of the investigations carried on may be noted: The phraseology and syntax of the fifth oration of Antiphon, the style of Andokides' third as compared with the first and second orations, Thrasymachos of Kalchedon, comparative study of the Trapezitikos and Aiginetikos of Isokrates, synonyms in the orators, the use of the participle in Greek lyric poetry, on the language of the oracles especially in Herodotos, special studies in the vocabulary of Dionysios.

The work of the seminary was supplemented by the study, with critical exercises, under the guidance of the Director, of the rhetorical works of Dionysios of Halikarnassos, and by a course of lectures on the History of Greek Oratory.

Besides the seminary course proper, Professor Gildersleeve delivered twenty-three lectures on Greek Syntax, conducted twenty-two exercises in translating at dictation from Greek into English and English into Greek, and gave a course of twenty lectures on Lyric Poetry. He also conducted a series of sixteen conferences in Greek Grammar for undergraduates.

Mr. Harris conducted class courses in New Testament Greek (three times weekly, first half-year, and five times weekly, second half-year), and in Sub-Apostolic Literature (three times weekly through the year); and gave a course of eight public lectures on the Perpetuation of Ancient Manuscripts.

Classes were conducted by Dr. Emerson in Classical Archæology (weekly through the year), in the Attic Judicial System (weekly, second half-year), and in the History of Ancient Art (twice weekly, second half-year).

Additional courses were conducted by:

Professor C. D. Morris, in

Plato, *Gorgias, four times weekly, first half-year.*
Aeschylus, *Persae;* Euripides, *Iphigenia in Tauris, three times weekly, second half-year.*
Reading at sight.

Dr. Spieker, in

Isocrates, I, IV; Xenophon, *Hiero, four times weekly, first half-year.*

Homer, *Iliad*, XVI–XVII; Euripides, *Hercules Furens, four times weekly, second half-year.*

Classes in Greek Prose Composition were also conducted by each of the instructors in connection with the courses above named.

Students have privately read for examination the following books:

Herodotus, *Merry's Selections*, (6).
Homer, *Odyssey*, XXI–XXIV, (6).
Xenophon, *Oeconomicus*, (7).
Plutarch, *Themistocles*, *Cicero*, (6).

Latin.

The Latin Seminary, under the direction of Dr. Warren, held two sessions a week throughout the year, the authors forming the centre of work being the Roman Satirists, especially Horace and Juvenal.

Some of the Fragments of Lucilius were read and discussed, select Satires of Horace and Juvenal were interpreted by the members of the Seminary, in turn, and papers were read by them embodying the results of special studies. Among the subjects thus treated were Juvenal's use of the gerund and gerundive; words borrowed from the Greek used by Horace and Juvenal; the use of the conjunction *cum* in Juvenal; the conditional sentence in Juvenal; the *sermo familiaris* as seen in Lucilius, Horace, Persius, Juvenal, and Petronius; the use of certain suffixes in Plautus, Terence, Lucilius, Horace, Persius, and Juvenal; the future active participle in Juvenal; the position of adjectives with respect to their substantives in Horace; the so-called Sulpiciae Satira; the use of the preposition *de* in Juvenal; the differences existing between the Satires and other works of Horace; some peculiarities of the Horatian Hexameter based upon statistics collected by members of the Seminary.

In connection with the Seminary work, Dr. Warren gave a course of weekly lectures during the first half of the year on the Roman Satirists. In the latter half of the year Dr. Warren conducted a weekly course of Practical Exercises in Latin.

Additional courses have been conducted during the year by:

Dr. Warren, in

Plautus, *Mostellaria*, and Terence, *Andria, three times weekly, first half-year.*
Tacitus, *Agricola*, *Germania*, *Annals*, I, *three times weekly, second half-year.*
Reading at sight, *weekly, throughout the year.*

Professor C. D. Morris, in

Cicero, *de Oratore* I, *Tusculan Disputations* I, *three times weekly, first half-year.*
Catullus and Martial, *Select Poems, three times weekly, second half-year.*
Reading at sight, *weekly, throughout the year.*

Dr. Spieker, in

Livy, II, III, *four times weekly, first half-year.*
Horace, *Select Odes, Satires, and Epistles, four times weekly, second half-year.*

Classes in Latin Prose Composition, meeting weekly, were also conducted by each of the instructors in connection with the courses above named.

Students have privately read for examination the following books:

Cæsar, *Bellum Civile*, (9).
Cicero, *de Senectute*, (1); *de Amicitia*, (9); *Tusculan Disputations*, II, (2); *Orator*, (2).
Horace, *Epodes*, *Carmen Saeculare*, (12).
Livy, V, VI, (1).
Ovid, *Fasti*, I, II, (12); *Selections*, (1).
Plautus, *Captivi*, (3).
Pliny, *Select Letters*, (2).
Tacitus, *Agricola*, *Germania*, (1); *Histories*, I, (1); *Annals*, III, IV, (6), IV, V, (1).
Terence, *Phormio*, (3).

Shemitic Languages.

The work of the past year was essentially a continuation of the courses begun during the session 1883–84. For beginners the only course given was in elementary Hebrew. The course in the elements of Biblical Aramaean presupposed a thorough knowledge of Hebrew. The Shemitic studies again centred in the Old Testament on which at first five, and later four, lectures a week were given.

In the *Hebrew course for beginners* the essential elements of the grammar were acquired (after Gesenius-Kautzsch's Hebrew Grammar, translated by E. C. Mitchell) and then the reading of the Pentateuch was entered upon.

In the *Hebrew Exercises* about forty chapters from the historical books of the Old Testament were read at sight: Exodus, 16; Genesis, 11 and 12; Jonah, 1 and 3; Job, 1 and 2; Exodus, 3 and 4; Judges, 19 and 20; 2 Samuel, 11; Numbers, 22; Judges, 11; 1 Kings, 17; Exodus, 31 and 32; 2 Kings, 19–21; Deuteronomy, 34, and Joshua, 1–2; Nehemiah, 1 and 2; Jeremiah, 37 and 38; 1 Samuel, 13; 1 Kings, 12 and 13; 1 Chronicles, 10, and 1 Samuel, 31, and 2 Samuel, 1; 2 Samuel, 12; Judges, 6; Ruth, 1 and 2; 1 Kings, 1 and 2; Nehemiah, 8 and 9.

In the *Critical Interpretation of Selected Psalms*, Psalms 23 and 1, and especially the fifteen post-exilic so-called Songs of degrees (Ps., 120–134) Hebrew *Shîrê hamma'alôth*, *i. e.*, the Songs of the Return (from exile) were thoroughly explained and critically analyzed, with special attention to textual criticism, date of authorship, and constant comparison with the ancient versions of the Psalter.

In the course in the *Elements of Biblical Aramaean* the forms were studied after the paradigm-tables in Baer and Delitzsch's edition of *Libri Danielis, Ezrae et Nehemiae* (Leipzig, 1882) and the first chapters of the book of Daniel read. This course was especially intended as a preparation for the study of Syriac.

In *Arabic* there was read the anecdote of a man of Baghdâd and his slave girl from the *Kitâb tazyîn el-aswâq* (Kosegarten's *Chrestomathia Arabica*, p. 22; Petermann, *Brevis linguae Arabicae grammatica*, p. 33; cf. Lane, *The Thousand and One Nights*, Vol. III, p. 524), and then extracts from the Travels of Ibn Baṭûṭah in the first volume of the Beyrut Arabic Chrestomathy *Majânî el-adab* (Beyrut, 1883, Imprimerie Catholique): No. 302, The sheikh Abdallah and the elephants; No. 309, The wagons in the Crimean (*Qifjaq*) Steppes; No. 313, Ibn Baṭûṭah's journey to the city of Bolgary; No. 344, Ermine and Sable; No. 320, Meteorites, and finally No. 314, Ibn Baṭûṭah's journey to China and his suffering in captivity. In addition the class met two hours weekly to read easy Arabic texts at sight, under the guidance of Dr. A. L. Frothingham, Fellow in Shemitic Languages; selections from the Chronicles of Abulfaraj, Fables, Anecdotes, etc., were read.

In *Ethiopic* the whole book of Baruch in Dillmann's *Chrestomathia Aethiopica* was explained. This was preceded by a series of lectures on the grammar of the Geez language.

In *Assyrian* a course of lectures was first given on Comparative Assyrian Grammar, after which the cuneiform account of the campaign against the Arabians in the Annals of King Sardanapalus (B. C. 668–626) was studied. This was read and explained from beginning to end (V R. 7, 82–10, 5).

In *Sumero-Akkadian* the Syllabaries and Vocabularies in the first part of Haupt's *Keilschrifttexte* were finished, besides the Akkadian Incantation No. 9 and the Sumerian Penitential Psalms No. 14 in Haupt's *Texts*, and finally the Sumero-Akkadian Family Laws (V R., 24).

All the courses were one hour a week through the year with the exception of Elementary Hebrew, Ethiopic, and Assyrian, to which in turn two hours a week were devoted.

Sanskrit and Comparative Grammar of the Cognate Languages.

During the session the following courses were conducted by Dr. Bloomfield:

1. *Elementary Sanskrit.* The most essential elements of the grammar of the classical language were acquired in as short a time as possible, and then the students were brought face to face with the language, learning its struc-

ture and laws, not in the abstract, but in its living body. This course served especially, as was found by practical experience, to furnish the students with a knowledge of grammatical analysis, clearer and more exact than that which they bring with them from other philological pursuits. This is due partly to the unrivalled transparence of the structure of the language, and partly to the tradition which has kept alive a close bond between Sanskrit and Comparative and Historical Grammar. Five books of the *Nala* and about a dozen selections from the *Hitopadeça* (both in Lanman's Reader), were read and thoroughly analyzed.

2. A second class in Sanskrit was conducted through a rapid course of reading in the *Hitopadeça* and *Kathāsaritsāgara*.

3. The advanced class in *Vedic Sanskrit* began with a short course in the *Brāhmanas*, restricting themselves to the characteristic selections in Lanman's Reader, which were thoroughly analyzed. The bulk of the year was devoted to an introduction into the *sūtra*-literature, and the relation of the *sūtras* to the hymns of the *saṁhitās*. Selections from *Āçvalāyana's gṛhya-sūtras*, including the hymns cited in them, were read, and their bearing upon Indian life and literature in general was discussed. A series of selections from the law book of *Manu* closed the work of the year.

4. A course in the *general principles of Comparative Philology* was carried on throughout the year. It was introduced by twelve lectures on the leading questions of Indo-European Comparative Grammar (*phonetic law and analogy, agglutination, the questions attaching themselves to the relationships of languages*, etc.). During the remainder of the year Professor Whitney's "Language and the Study of Language" was made the basis of instruction, but this was constantly supplemented by lectures, which aimed to advance the subjects treated in the book up to the present day.

5. A course in *Comparative Grammar of Greek*. This was devoted especially to a detailed exposition of the latest theories on *Indo-European vocalism*, and to a practical application of them to the body of the Greek language. Incidentally other important chapters of Greek Grammar, especially the *guttural series of consonants*, and *questions on accentuation*, were treated. The most important phenomena in the vocalism of the principal related languages, Latin, Gothic, and Sanskrit, were also presented.

German.

Dr. Wood conducted the following advanced courses:

Gothic. *Twice weekly, first half-year.* The selections from Ulfilas in Braune's grammar were read and explained. A historical and critical introduction to the study was given, together with four lectures on the history of the Gothic declensions, and four on Gothic syntax.

Old High German. *Weekly, first half-year, twice weekly, second half-year.* The following parts of Braune's Reader were read: Nos. 4, 5, 9, 16 (Tatian), 17 (The Strassburg Oaths), 28 (Hildebrandslied), 29, 30 (Muspilli), 31, 33, 34, 35, 36, 39, 40, 41, and part of 32 (Otfrid). Seven lectures were given on the High German Mutation of Consonants.

Middle High German. *Weekly, through the year.* Paul's Grammar (second edition) was used. Selections (about half) from Walter von der Vogelweide (Wilmann's second edition), and one third of Hartmann's *Iwein* (ed. Benecke-Lachmann) were read. Four lectures were given on Middle High German Metre.

German Comparative Grammar. (Lectures). *Weekly, second half year.*

The undergraduate classes were conducted by Dr. Wood and Mr. Hempl, as follows:

Major Course:

German Literature. Lectures. *Weekly.* Dr. Wood.
Goethe: *Hermann and Dorothea; Faust I. Twice weekly.* Mr. Hempl.
Selected Readings. Masius: *Lesebuch III. Weekly.* Dr. Wood.
Prose Composition. *Weekly.* Dr. Wood.
Exercises in German Style. *Monthly.* Dr. Wood.

Minor Course:

Lessing: *Minna von Barnhelm; Prosa.* Goethe: *Prosa.* (*Two Sections*). *Twice weekly.* Mr. Hempl.
Selected Readings. Oltrogge; *Lesebuch II.* (*Two sections*). *Twice weekly.* Dr. Wood and Mr. Hempl.
Prose Composition. *Weekly.* Mr. Hempl.
Oral Practice. *Weekly.* Dr. Wood.

A class in German conversation was conducted by Dr. Gerber daily, through the year.

Supplementary Classes:

First Section: Brandt's Grammar, Deutsch's Reader. Schiller: *Lied von der Glocke* (ed. Otis). *Three times weekly.* Mr. Hempl.
Second Section: Otis: Elementary German. Ludwig: *Schloss Heimburg. Five times fortnightly.* Mr. Hempl.

English.

Advanced courses were conducted as follows:

Anglo-Saxon: Béowulf. *Weekly.* Dr. Wood. Seven lectures on Germanic Mythology were given with this course.

Anglo-Saxon Grammar. Lectures. *Twice weekly, during March, April, and May.* Dr. J. W. Bright.

Additional classes, including the first and second year's courses for undergraduates were conducted as follows:

The minor (first year's) course was directed by Dr. Browne. The first half-year of this course was devoted to the Elizabethan writers. The work included a study of the period and its influences, the prose-writers, lyrists, and allegorical writers, and the rise and development of the drama. Shakespeare's *Julius Cæsar* (Clark and Wright's edition) was carefully studied as class-work. The later Elizabethan drama was illustrated by Webster's *Duchess of Malfy*, and Fletcher's *Rule a Wife.* Abbott's *Shakespearian Grammar* was recommended for reference. The second half-year was employed in the study of fourteenth century literature. Texts studied in class were Chaucer, *Nonne Prestes Tale* (ed. Morris) and Langland, *Piers the Plowman*, Passus 1–3, 5–6 (Skeat's edition), and the period was further illustrated from Wyclif, the pseudo-Chaucer, and *Pierce the Ploughman's Crede.*

The major (second year's) course included instruction in Anglo-Saxon with Mr. C. B. Wright, twice weekly, through the year; Sievers' *Grammatik*, Sweet's *Reader*, and Cynewulf's *Elene* (ed. Zupitza) were used as text-books. Mr. A. E. Egge also conducted a class in Early English, twice weekly, through the year; Skeat's *Tale of Gamelyn*, and Morris's *Specimens of Early English, Part I*, were read.

The work in English done in the P. H. E. course (required of all undergraduates) was conducted by Dr. Browne and was directed with the view of giving the matriculates a sound general conception of the whole body of English literature from the earliest times down to the present century. No manual was used, the students being brought into contact with the original texts, except in the case of writers earlier than the fourteenth century, where the examples selected for illustration were modernized by the instructor. The class read aloud, under the instructor's guidance, Chaucer's *Prologue* and *Knightes Tale* (Morris's edition), and Shakespeare's *Hamlet.* The ground covered by the course extended from *Béowulf* to Burke.

Courses of public lectures were given on:

English Poetry and on the Poet Gray, by Mr. Edmund Gosse. (8).
Shakespeare, by Professor Hiram Corson. (20).
Phonetics, by Mr. A. Melville Bell. (7).
Shakespeare Bibliography, etc., by Mr. Justin Winsor. (2).
Shakespeare (Readings), by Mr. D. C. Bell. (2).

A Shakespeare Circle was formed under the general guidance of Dr. Browne and Dr. Wood, and held several conferences through the session.

Romance Languages.

Advanced courses were conducted as follows:

The Romance Seminary, under the direction of Mr. Elliott. *Two hours a week through the year.*

The work was concentrated on three of the earliest Old French Monuments, namely, the *Cantilène de Sainte Eulalie, Fragment de Valenciennes* and part of the *Passion du Christ.* The examination of these texts was on MS. fac-similes and bore upon both matter and form. Their mixed dialect character, their phonological and morphological relations to the Classic and Low Latin, to the oldest products of the other Romance Languages, to the later Old French Documents and to the Modern French Language, formed the bulk of material with which the Seminary was occupied. In connection with the Eulalia Hymn, considerable time was spent in a study of the Latin Sequentia of the Middle Ages and of their relation to the literary forms that preceded and followed them. This course was followed by the most advanced students only. In addition to it a Seminary meeting was held once a week in which all special students of this department took part. The subjects here discussed were of a more general nature, and such as might fitly claim the attention of first year men, who thus had the benefit of direct and active association with their more experienced co-workers in the field.

Introduction to Old French Philology. *Aucassin et Nicolète* was critically studied with special reference to its phonology and morphology as compared with the Classic Latin, on the one hand, and with the Modern French, on the other. The leading characteristic forms of the dialect here represented were constantly contrasted with corresponding ones in the Ile-de-France species. *Weekly through the year.*

Wallachian:—The whole of Cionca's *Practische Grammatik der rumänischen Sprache* was worked through and short poetical extracts read from Alexandri, Alesandrescu, Muresianu and Sionu. *Weekly, second half-year.*

Lectures:—(*a*) On the Langue d'Oïl Dialects. The object of this course was to give the leading characteristics of the chief dialect groups that constitute the North French. The system followed in carrying out this idea was, first, to put before the student, in short lectures, the distinguishing traits of each dialect, and, then, to follow these with selections of texts which were translated and their dialect peculiarities pointed out by the student himself.

(*b*) The History of Romance Studies in Europe. The history of the various theories with reference to the origin and growth of the Romance Languages was succinctly given, the productions of individual scholars that have worked in the field were characterized, and the chief works, monographs, and articles of those now engaged in Romance studies were noted, and critical remarks made on their general bearing and worth for the subjects which they treat. This course was intended to put the student abreast of the present scientific production in this field. *Weekly.*

(*c*) Comparative Romance Phonology. Here an attempt was made to group together the general laws bearing upon the same subject in Romance Phonetics, to note the action of like tendencies to law in different members of the group and to classify the more important differences of phonetic development according to their genetic relations. *Weekly.*

(*d*) Modern French Phonetics. This course, together with the Introduction to Old French Philology, as given above, was intended for first year students who wished to become specialists in the Romance Languages. The student was held here to modern forms exclusively and taught to make use of scientific methods. *Weekly.*

(*e*) The History of the Past Participle in French. *Three Lectures.* These lectures were given to call the special attention of first year students to modifications in the treatment of this important grammar category, as proposed by certain modern grammarians.

The undergraduate courses were as follows:

The students of the French Major Course have read with Dr. Todd:—In Bartsch's Chrestomathie, the selections from *Les plus anciens monuments, St. Alexis, Amis et Amiles, Bestiaire de Philippe de Thaün, Mystère d'Adam, Tristran, Roman de Rou, Contes del Graal, Sermon de Saint Bernard, Roman de Renart, Roman de la Rose, Villehardouin, Froissart, Philippe de Comines, Perceforest;* and the whole of the Oxford text of the *Chanson de Roland.*

Dr. Todd has also given, in this course, seven lectures on the French Literature of the Middle Ages.

The students of the French Minor Course have read with Dr. Todd:—*Le Voyage autour de ma Chambre* by Xavier de Maistre, *Les Jumeaux de l'Hôtel Corneille* by Edmond About, *Les Mésaventures d'un Ecolier* by Töpffer, *Le Barbier de Séville* and the *Lettre critique sur le Barbier de Séville* by Beaumarchais, and *Hernani* by Victor Hugo. Twenty-minute talks on French Literature upon the basis of Saintsbury's *Primer* have been given in connection with the above readings;—With Mr. Bowen they have read 110 pp. of Montesquieu, *Grandeur et Décadence des Romains*, 75 pp. of Masson, *French Classics, Vol. VII.*, (Memoirs of 17th Century); 100 pp. of Milne-Edwards, *Précis d'Histoire Naturelle*, and in connection with this, studied 150 pp. of Breymann's *French Grammar*;—With Mr. Fontaine they have studied and prepared written exercises on the whole of Part I. and fifty *thèmes* of Part II. in Chardenal's Exercises for Advanced Pupils.

Mr. Fontaine has met the students of the Minor Course five times weekly for French conversation with systematic instruction and drill in pronunciation.

Dr. Todd has conducted special courses in Italian, Spanish, Catalan, Old Provençal, Modern Provençal, and Portuguese:—The class in Italian have read the following authors. Goldoni: *Gl' Innamorati;* Manzoni: *I Promessi Sposi* (one hundred pages); Machiavelli: *Istorie Fiorentine* (second book); selections from Leopardi; and a short *Storia della Letteratura Italiana.* Exercises in grammar have been given twice weekly in connection with the above.

The class in Spanish have read the following: Knapp's Spanish Readings (one hundred and fifty pages); *El Barómetro* (comedia); *Don Quijote* (ten chapters); and 1200 verses of the *Poema del Cid* (XII Century). Exercises in grammar have been given twice weekly.

In Catalan the *Cronaca* of Ramon Muntaner, Chapters VI. to XXVII. (Cardona's *Dell' Antica Letteratura Catalana*), was read.

In Old Provençal were read the *Poème sur Boèce;* selections from *Girart de Rossilho*, from the poetry of Marcabrun, Bernart de Ventadorn, and Peire d'Alvernhe; and all the prose of Bartsch's Chrestomathie. In Modern Provençal, three cantos of Mistral's *Mirèio* were critically studied.

The class in Portuguese have read three cantos of Camoens' *Lusiads*, and numerous selections from Braga's *Antologia Portugueza*, covering the most ancient period of the language.

Ten public lectures on Romance Literature were given in Hopkins Hall. Three of these by Dr. H. A. Todd, on *Contemporary Spanish Literature*, embraced: I, Contemporary Poetry in Spain; II, The Modern Spanish Novel; III, The Orators and Drama of Modern Spain. Seven lectures, by Associate Professor Elliott, on *Camoens*, covered: I, II, Sketch of Portuguese History to the Death of Camoens; III, Life of Camoens; IV, Minor Works of Camoens; V, VI, The Lusiads; VII, Camoens at Home and Abroad in the Nineteenth Century.

Two public courses on French Literature, including twenty-five lectures and readings (in French) were given by M. Rabillon.

The JOHNS HOPKINS PHILOLOGICAL ASSOCIATION has met monthly as heretofore. Papers have been read during the session by:

C. ADLER.—On the Etymology of Elixir; Note on the Catalogue of the Books of the Bible in the MS. of the "Teaching of the Twelve Apostles."

W. M. ARNOLT.—On some Oracles in Herodotus.

M. BLOOMFIELD.—Two Etymological Notes; the probable Sanskrit Equivalent of the Greek particle *ἀρ, ῥα*; on a New Group of Vedic Words, belonging to the root *praç.*

J. M. BRIGHT.—Some account of King Alfred's Anglo-Saxon Version of the *De Consolatione Philosophiae* of Boethius.

A. M. ELLIOTT.—On a Philological Expedition to Canada.

A. EMERSON.—On Petrarca's Relations to the Universities of his time.

A. L. FROTHINGHAM.—On the Meaning of Baalim and Ashtaroth in the Old Testament.

W. E. GATES.—Some Notes on the Elene and Cynewulf.

B. L. Gildersleeve.—On Weil's view of the origin of the word "Poet"; on the Final Sentence in Classic Greek Prose; Report and Criticism of Weber's *Entwickelungsgeschichte der Absichtssätze.*

J. R. Harris.—The Western Readings of the New Testament; on the Codex Martinianus of the New Testament.

P. Haupt.—On a Eucharistic Sermon by John Chrysostom preserved in Ethiopic.

A. H. Huizinga.—The Lessons of the Peloponnesian War as developed in the Speeches of Thucydides.

M. D. Learned.—The English Element in Pennsylvania German.

C. D. Morris.—Some account of Beloch's Speculations on the Financial History of Athens.

E. M. Pease.—On the Relative Value of the MSS. of Terence collated by Umpfenbach.

E. H. Spieker.—On the Dialects of North Germany.

M. Warren.—On the Etymology of Hybrid; on some old glosses in Codex Sangallensis 912.

H. Wood.—On the Persistence of Alliteration in English.

The fifth volume of the American Journal of Philology has been completed during the year, and the first number of the sixth volume has been issued.

HISTORY AND POLITICS.

PROGRAMME FOR 1885-86.

I. Graduate and Advanced Courses.

1. Seminary of History and Politics.

Only graduate students who have satisfied the director of the Seminary, Dr. H. B. Adams, that they are competent to pursue special studies in History and Politics are admitted to full membership of the Seminary. This is a select body of instructors and advanced students pursuing original investigations in the field of American Institutions and Economics upon a coöperative plan.

During the coming year attention will be centered upon the administrative institutions of the United States. The various departments of the federal government will be considered historically and practically by the instructors and other members of the Seminary. The exercises are held in the Historical rooms of the Library on Friday evenings, from eight to ten o'clock.

2. Historical and Political Science Association.

Once a month a public meeting of the Seminary will be held for the presentation of papers and abstracts of original work which are of more general interest than are the exercises of the Seminary. Occasionally lectures upon themes kindred to Seminary work will be given to the Association by specialists from other universities and by representatives of certain departments of the United States Government.

3. History of Politics.

Two hours weekly through the year, by Dr. H. B. Adams.

A continuation of the subject described under the "Work of the Past Year," see p. 105. During each of the three years in the graduate curriculum of this department, it is intended that there shall be one representative course of lectures in Ancient and one in Modern Politics, and that History shall be studied chiefly in its bearings upon Institutions of Government and the development of the Modern State. During the coming year attention will directed, in one course, to Roman Institutions and, in the other, to Modern European Politics, particularly since the French Revolution. In addition to the regular lectures, occasional oral and written examinations will be required upon branches of general history, which must be studied in private readings and, if necessary, in the class courses elsewhere described.

4. Advanced Political Economy.

Two hours weekly through the year with Dr. R. T. Ely.

This course opens with a discussion of the fundamental principles of the science and is specially devoted to practical economic problems, such as the Tariff, Coöperation, Joint-stock Associations and other forms of Partnership, Strikes, Immigration, Wages, etc. The course requires such previous acquaintance with the elements and history of Political Economy as that afforded in the undergraduate classes of this department. Original investigation is not encouraged until the requisite preliminary work has been tested by oral and written examinations.

5. Comparative Studies in Administration.

Once weekly through the year, by Dr. R. T. Ely.

Lectures on methods of administration in France and Germany, with a view to the encouragement of administrative studies in the United States.

Arrangements have been made by the teachers of Modern Languages, French, German, and Italian, for courses of historical readings. French and German are required of all graduate students in History and Politics for the proper prosecution of their advanced work. Lectures in the History of Education are given by Professor G. Stanley Hall.

II. Undergraduate Courses.

History.

First Year.

1. Classical Course in History.

Five hours weekly, through the year, with the instructors in classics.

This course requires: (1) the reading of select portions of Livy and Tacitus in the Latin texts; (2) the reading of Herodotus and Thucydides in English translations; (3) an historical examination upon the entire subject matter contained in these authors.

Second Year.

2. Modern Course in History.

Five hours weekly, through the year with Dr. H. B. Adams, *aided by an associate instructor.*

A class course in European History, beginning with the Roman Empire and the rise of Christianity. Special attention is given to the origin of Teutonic States, the Frankish and German Empires, the Italian Republics, the rise of Nationalities, the Renaissance and Reformation, Modern Absolutism and Revolutions particularly in Holland, England, France, and Germany. Varying courses of study in this modern field are offered in alternate years.

The text-books employed in the Modern course in History are Ploetz's Epitome of Universal History, Bryce's Holy Roman Empire, the Student's France, Green's Short History of the English People, with select readings from Gibbon, Milman, Symonds, Ranke, Motley, etc. Five historical essays and numerous oral reports upon assigned topics are required of all undergraduate members of the class.

Politics.

First Year.

3. Political Economy and Modern Social Problems.

Five hours weekly through the year, with DR. R. T. ELY.

The first half-year is given to the elements of Political Economy as defined in John Stuart Mill. The second half is devoted to a consideration of modern social problems, communism, socialism, the relations of capital and labor, trades unions, coöperation, etc. Essays involving the study of a variety of authors are required of each member of the class. The aim of the course is to familiarize the student with the principles of Political Economy, the main results of economic research, and the historical development of modern social theories. Oral and written examinations are frequently instituted throughout the course.

Second Year.

4. International Law and Modern Constitutions.

Five hours weekly through the year with DR. H. B. ADAMS, *aided by an associate instructor.*

Two hours a week throughout the year are given to a study of the History and Elements of International Law, and three hours a week to the Constitutional and Administrative Law of England and the United States. The text-books employed are Bluntschli's *Moderne Voelkerrecht der Civilisirten Staaten*, Bagehot's treatise on the English Constitution, certain volumes in the English Citizen Series, and the writings of Cooley, von Holst, and other standard authorities on the Constitution of the United States.

Library.

The students have free access to a special collection of historical books, numbering 10,000 bound volumes, and perhaps as many pamphlets and monographs. These are conveniently arranged and indexed. The collection includes the private library of the late Dr. Bluntschli, of Heidelberg, and many important volumes which have been purchased by or presented to the University. Special mention may also be made of the valuable libraries of the Peabody Institute and of the Maryland Historical Society.

WORK OF THE PAST YEAR, 1884-85.

I. Seminary Work.

The Seminary of History and Politics, under the direction of Dr. H. B. Adams, has met once a week during the past academic year, each session occupying two hours. Attention has been confined to select topics of American Institutional and Economic History.

Among the original papers were the following: Pullman, a Social Study, by R. T. Ely; The House of Representatives, by Woodrow Wilson; City Government of Baltimore, by John C. Rose; City Government of Chicago, by F. H. Hodder; Introduction to the Study of the Constitutional and Political History of the individual States, a series of three papers, by J. F. Jameson; The Republic of New Haven and its Colonies, a series of chapters, by C. H. Levermore; The History of American Political Economy, in successive chapters, by Woodrow Wilson and Davis R. Dewey; Institutional and Economic History of Pennsylvania, a series of contributions by W. H. Holcomb, W. B. Scaife, and T. K. Worthington; The Puritan Colony Annapolis, by D. R. Randall.

II. Publications.

The second volume of Johns Hopkins University Studies in Historical and Political Science, edited by Dr. H. B. Adams, was completed in December, 1884. The volume embraces twelve numbers and is devoted especially to "Institutions and Economics."

The first volume was confined to "Local Institutions." Among the monographs published in the second series by members of the Seminary since the last report in the *University Circulars* (June, 1884) are Rudimentary Society among Boys, by John Johnson, Jr., A. B.; Land Laws of Mining Districts, by C. H. Shinn, A. B.; Maryland's Influence upon Land Cessions to the United States, by Dr. H. B. Adams; Local Institutions of Virginia, by Edward Ingle, A. B.; Recent American Socialism, by Dr. R. T. Ely; Local Institutions of Maryland, by L. W. Wilhelm, Ph. D.

During the past year three books have been written by members of the Seminary: (1) Icaria, a Study in American Communism, by Albert Shaw, Ph. D., published by G. P. Putnam's Sons, New York, 1884; (2) Congressional Government, a Study in American Politics, by Woodrow Wilson, Fellow in History, published by Houghton, Mifflin & Co., Boston, 1885; (3) Mining Camps, a Study in American Frontier Government, by Charles Howard Shinn, A. B., published by Charles Scribner's Sons, New York, 1885.

III. Class Courses.

Dr. H. B. Adams has conducted a class course for graduates in the History of Politics, three hours a week through the year.

The course consisted of (1) lectures by Dr. Adams upon Greek, Roman, and Mediæval Theories of Politics, supplemented by student-reports on Modern Political Theories; (2) oral examinations upon Greek politics, historically considered; (3) lectures upon Modern European Politics, supplemented by the exposition of Bluntschli's *Lehre vom Modernen Stat.*

To undergraduates Dr. Adams has given the following courses of instruction:

1. Fifteen introductory lectures on Ante-Classic History, with Keary's Dawn of History and Clodd's Childhood of Religions for text-books.
2. Two hours a week through the year on Church History in its relations to the Roman and German Empires, followed by lectures on the Italian Renaissance. The text-books employed were Ploetz's Epitome of Mediæval History and Bryce's Holy Roman Empire, with required readings in Gibbon's Decline and Fall of the Roman Empire and Milman's Latin Christianity. Two historical essays were required from each member of the class.
3. Two hours a week through the year on the History and Elements of International Law, a course consisting of lectures, the exposition of Bluntschli's *Moderne Voelkerrecht der Civilisirten Staaten*, and reports by members of the class upon international topics. This course, with Dr. Jameson's three hours a week on the English and American Constitutions, constituted the second year in Politics.

Dr. R. T. Ely has given the following courses to graduate students:

1. Two lectures a week on Finance and Taxation. This course comprised an exposition of the general principles and history of money, banking, and finance, also the special subject of taxation in the Cities and States of the American Union, and a sketch of the financial history of the United States. Papers were prepared by members of the class, and class discussion was continually encouraged.
2. One lecture was given each week throughout the first half-year on the principles and historical growth of Commerce. It is hoped that this course will lead to original investigations in the History of American Commerce.
3. One lecture weekly was given throughout the second half-year on methods of Administration in England, Germany, and France. The special subjects treated were the organization of government, bureau-

cratic and self government, economic functions of government, sanitary legislation, poor laws, appointment and tenure of office, etc.

To undergraduate students Dr. Ely gave a course of class instruction, five hours a week through the year.

This comprised the first year in the course on Political Science. The first term was devoted to the Elements of Political Economy; the second, to the History of Political Economy. Essays upon assigned topics were required from all members of the class.

Dr. J. F. Jameson has conducted class courses as follows:

1. In Physical and Historical Geography (twenty exercises); in the History of Greece down to the time of the Roman conquest, and in the History of Rome and of the Roman Empire down to the fifth century A. D., two hours weekly through the year. The text-books employed were Tozer's Classical Geography, Fyffe's Greece, and Leighton's Rome.
2. In the History of France and England, employing as text-books the Student's History of France and Green's Short History of the English People. Three essays were required. This course, three hours weekly through the year, was in connection with Dr. Adams' class course of two hours a week on Church History, German Empire, and the Italian Renaissance.
3. In the second year's course in Politics, devoting three hours a week to the Constitutions of England and of the United States, and using for that purpose two volumes in the English Citizen Series,—Walpole's Electorate and Legislature and Traill's Central Government,—also Bagehot's treatise on the English Constitution, and selections from the principal authorities upon the Constitutional Development of the United States.

PSYCHOLOGY AND PEDAGOGICS.

PROGRAMME FOR 1885-86.

I. Advanced Courses.

Professor G. Stanley Hall will conduct the following courses: —

1. General Systematic Psychology, — *semi-weekly lectures and weekly conferences, through the year.*

These lectures will begin with the psycho-physics of each of the senses and pass to that of the cerebro-spinal nerve centres, including a general survey of the field of physiological-psychology. The field includes such topics as compound reflex-action and instinct in animals, memory, association of ideas, attention, volition, and aesthetic and general feeling and emotion. The contributions of psycho- and neuro-pathology to the understanding of normal function and histology of the cerebro-spinal nervous system will receive special attention. The psychology and pathology of speech and writing will be illustrated. Much attention will also be given to the psychical parts of anthropology and its present problems, methods, and results, including recent studies on the evolution of the psychic faculties in children and the race. This will introduce the psychology of national and other comprehensive systems of opinion and thought and, in short, the endeavor will be to give as briefly as possible, with the many demonstrations, experiments, and illustrations involved in parts of the course, a brief survey of the vast field of modern scientific psychology, which, while leaving out nothing essential in the old philosophical disciplines, vivifies them by bringing to them a new standpoint, a new method, and a vast body of pregnant and experimentally demonstrated facts.

This course is intended for special students of psychology, and they should have at least such an acquaintance with elementary Logic, Ethics, and Psychology, as may be acquired in the undergraduate courses of this and other collegiate institutions. Students of biology and of medicine who desire to study the psychic functions of animals, and especially of man, may attend this course. A limited number of qualified students will be encouraged to investigate certain themes in the rooms devoted to psycho-physical research, where suitable instruments are provided. The apparatus for the study of dermal sensation and for fine chronographic work is quite complete. Arrangements have been made by which the results of investigations may be published in *Mind.*

Dr. H. H. Donaldson, during the first half-year, will deliver a course of lectures on biological topics of importance to students of psycho-physics, and in connection with it will give practical lessons twice a week in the histology of the senses and central nervous system in man, with special reference to recent localization studies.

2. Pedagogics,—*a weekly lecture, and a weekly conference, through the year*, on the History of Educational Institutions and Theories,—beginning with the Greeks.

For an account of the topics of this course, see the sketch given below in the report of the past year.

3. History of Philosophy,—*twenty-five lectures.*

The early part of this course will be parallel with Professor Gildersleeve's seminary course which is to be devoted this year to Plato. The latter part of the course will be devoted to the philosophers of the middle ages, and to the modern writers in England, France, and Germany. This course is intended not only for special students of philosophy but for students of literature and history.

II. Course Required of all Matriculated Students.

This course will comprise five hours per week throughout the year, and includes Logic, Ethics, and Psychology. A special instructor will be appointed for this work, which will consist of lectures, recitations, themes, epitomes, etc. These subjects will be taken up in the following order.

1. Inductive and Deductive Logic.

Text-books: Fowler, with references to Jevons, Mill, and Wundt.

2. General Psychology.

Text-books: Sully and Lotze's Psychology in selections, with references to Porter, Ryland, and Carpenter.

3. Ethics.

This part of the course will be taught in part by lectures and will comprise such topics as mental and physical regimen and hygiene, methods and general ends of study, the needs and sanctions of positive personal convictions and purposes in the conduct of the understanding and of life, mental self-knowledge as opposed to self-consciousness, and the utilization of individual experience in self-education, social ethics, need of religious sentiments for the maturity and sanity of conscience, etc.

Books of reference: Maurice's *Social Morality*, Grote's *Treatise on the Moral Ideals*, Wuttke's *History of Christian Ethics*, Wayland's *Moral Philosophy*, Calderwood's *Moral Science*.

4. In addition to the above required courses, a series of lectures will be given by Professor Hall, during the latter part of the year intended to introduce the matriculated student to the advanced study of philosophy.

WORK OF THE PAST YEAR, 1884-85.

Professor G. Stanley Hall lectured twice weekly through the year on Psychology.

This course was in the main a continuation of the course begun the previous year, which was on the psycho-physics of the senses. The lectures began by describing the recent methods and results in the study of instinct. The topics of psycho-genesis, disorders of speech, illusions, the psychological aspects of insanity, localization studies in spinal cord and brain, psycho-physic time and the time sense, apperception and will, and psychological anthropology, were treated with charts, illustrations and literature.

Four students were engaged in original psycho-physic research, the results of which will be made public in due time.

Two weekly conferences were held by Dr. Hall during the last half-year, one devoted to ethics and the other to scientific topics in psychology.

Professor Hall lectured once weekly through the year on Education. The topics considered were these:

Student life, and societies and customs in the middle ages, introduced the history of the Italian, French, English and German universities, their organization and legislation, courses of study, &c. Then followed a sketch of the development of primary and secondary State and private schools, their organization, relation to the State, courses of study, with a detailed account of the work in a typical gymnasium, real-school, and French and English schools of a similar grade. The educational ideas of Comenius, Sturm, Locke, Montaigne, Herder, Pestalozzi, Rousseau, Kant, Niemeyer, Schwartz, Graser, Schleiermacher, Herbart, Waitz, Beneke, and contemporary writers were epitomized. The development of modern methods in a few cardinal branches of common school study was given with many illustrations. The history of English and Prussian school legislation was outlined, and the unfoldment and present condition of industrial education in the different countries was sketched. Classical, female, professional education, were treated historically, and the course concluded with an account of the institution and philosophical ideals of education in ancient Greece.

A course of twelve lectures on educational topics was given on Saturday mornings to a company of about one hundred graduate students. Lectures were given by President Gilman, and by these members of the academic faculty: Messrs. Hall, Newcomb, Bloomfield, Brooks, Craig, Elliott, Ely, Harris, Hartwell, Story, and Warren.

A few lectures were given by Professor Hall in Mental Hygiene to the undergraduate students.

Professor G. S. Morris gave the following courses:

History of Philosophy in Greece. *Twice weekly, first half-year.*

Topics involved: — The beginnings of science. Anticipations of the modern doctrine of development. Establishment of elementary conceptions of physical science. First application of mathematical conceptions to the comprehension of the universe. Beginnings of abstract speculation. First successful development of concrete or substantial idealism, including science of method (logic), and philosophy of nature, man, the State, art, and education. Systems of practical philosophy.

Ethics, or the Science of Man. *Two lectures weekly, first half-year.*

A consideration of the foundations and content of ethical science, together with an historical survey.

The Metaphysical Club met monthly through the year for the presentation and discussion of papers.

INFORMATION FOR APPLICANTS FOR ADMISSION TO THE UNIVERSITY.

Printed in response to Letters.

GENERAL STATEMENTS.

How was the University founded?

The Johns Hopkins University was instituted by the munificence of a citizen of Baltimore, Johns Hopkins, who bequeathed the most of his large estate for the establishment of a University and a Hospital. The foundation of the University is a capital, in land and stocks, estimated in value at more than $3,000,000; the capital of the Hospital is not less in amount. The University was incorporated under the laws of the State of Maryland, August 24, 1867, and it was opened for instruction in September, 1876. The Philosophical Faculty (of Letters and Science) is now organized. A medical department will soon be instituted.

In what is instruction given?

Systematic instruction is offered in English, Anglo-Saxon, German, French, Italian, Spanish, Latin, Greek, Sanskrit, Hebrew, Arabic, and in other languages and literatures; in Pure and Applied Mathematics; in Chemistry, (Inorganic and Organic) with laboratory work; in Physics, (including Mechanics, Light, Heat, Sound, Electricity, Magnetism, etc.) with laboratory work; in Biology, (including Physiology and Morphology) with laboratory work; in Mineralogy and Geology; in Ancient and Modern History; in Physical Geography; in Political Economy and in the elements of International Law; in Logic, Ethics, Psychology, Pedagogics, etc. Occasional courses of lectures are also given upon special themes in Literature, Science, History, Archæology, Art, etc.

To whom is this instruction offered?

To all young men who are prepared to profit by it and who will conform to the simple regulations which are established by the authorities. Graduate, Undergraduate, and Special Students are received.

Those who have not already received an academic degree, should aim to secure one by pursuing a liberal and prolonged course of study, at the close of which the degree of Bachelor of Arts will be conferred. Those who may be prevented from seeking this degree, will nevertheless be welcomed to the University, provided that they are in earnest and are mature enough in years, attainments, and character to profit by the advantages which are here afforded. Others who have already taken their first degree are encouraged to go forward in advanced lines of work, and for them unusual facilities are provided. Young men who are to pursue the study of Law, Medicine, or Theology, or who have entered upon professional lives, and others who expect to become teachers, if they desire to become proficient in literature and science, have easy access to the class-rooms and laboratories. The degree of Doctor of Philosophy may be obtained, after three years of advanced study, by those who have met the required conditions.

How is this instruction given?

By all the methods which experience has shown to be useful,—varying according to the preferences of the teachers, the subjects taught, and the number of scholars. There are recitations, lectures, conferences, prolonged courses in laboratories, exercises in special libraries, personal counsel, study of nature out-of-doors. The usual four-year classes are not maintained, but in all the principal subjects taught, there are beginners, intermediate students, and advanced workers; so that every scholar is assigned to that position in each section of the university which will yield him the greatest advantages. He may be far advanced in one subject and only a beginner in another. This result is only secured by the engagement of a large staff of teachers.

What are the Laboratory and Library Facilities?

The scientific laboratories are three in number. They are open throughout the day and are fully equipped. For Chemistry, there is a special building arranged for about ninety workers, and well adapted to all kinds of chemical and mineralogical work. A large building has been recently constructed for a Biological Laboratory, with complete arrangements for physiological and morphological work. The Physical Department is furnished with apparatus selected both for demonstration and investigation, and especially valuable for researches in electricity, magnetism, light, and heat. The construction of a new building for a Physical Laboratory is now under way.

The Library includes over 26,000 bound volumes, and six hundred and fifty serials are regularly received. It is open thirteen hours daily. The Library of the Peabody Institute, with 80,000 volumes, and the other Baltimore libraries are of easy access. Washington is so near that the Library of Congress, the National Museum, and the other libraries and museums of the capital may be readily visited.

What are the necessary expenses of a Student?

The charge for tuition in all departments, (including the use of the library, and without any extra charges except for materials consumed in the laboratories), is $100 per annum, payable one-half October 1, and the other half February 1.

Young men living in any part of Baltimore, or in the immediate vicinity, can lodge at home, as the first lessons are given at 9 a. m. daily, and there is rarely any required exercise as late as 5 p. m. Young men from a distance can readily find rooms and good board either in private dwellings or in boarding houses. It is possible to secure accommodations (room and board) for five or six dollars per week, and for a sum between six and ten dollars per week it is still easier to be suited. The other necessary expenses of life are moderate.

Are there any scholarships?

In accordance with the request of the founder of the University, twenty Hopkins scholarships, giving free tuition, are annually conferred upon matriculated undergraduate students from Maryland, Virginia, and North Carolina. In addition to these scholarships, eighteen Honorary Hopkins scholarships, yielding two hundred and fifty dollars and free tuition, are offered to those collegiate students from the three States above named who pass the matriculation examinations with the most credit. Two scholarships giving free tuition are also open to matriculated students from the District of Columbia. Twenty scholarships yielding two hundred dollars, and twenty fellowships yielding five hundred dollars are annually open to graduate students.

GRADUATE COURSES.

What special opportunities are offered to University Students?

Advanced and graduate students are received with or without reference to their being candidates for a degree, and they are permitted to attend such lectures and exercises as they may select. They are not examined for admission to the University, but each instructor satisfies himself of the attainments of all who wish to follow his guidance before admitting them to his classes.

Systematic courses of instruction, varying every year, are announced in the annual programme. The professors are free to give personal counsel and instruction to those who seek it; books and instruments adapted to investigation and advanced work have been liberally provided; the system of Fellowships secures the presence of twenty special students imbued with the university spirit, most of them looking forward to academic careers; seminaries limited to a few advanced students under the guidance of a director have been organized in various subjects; societies devoted to Philology, to Mathematical, Physical, and Natural Science, to Metaphysics, to History and Political Science, and to Archæology, afford opportunities for the presentation of memoirs and original communications, and there are also clubs for the reading and discussion of Biological, Physical, and Chemical papers; during the year, courses of lectures are given by resident and non-resident professors on topics to which they have given special attention; the libraries of the Peabody Institute and Maryland Historical Society, founded for the advantage of scholars, are easily accessible; the issuing, under the auspices of the Trustees, of publications devoted to Mathematics, Chemistry, Philology, Biology, and History, brings the University into advantageous connection with other foundations; special libraries connected with the seminaries bring the most important works within easy reach of the student, and the University reading-room, which is constantly open, is liberally supplied with new and with standard books and with the literary and scientific journals of this and other lands.

On what conditions is the Degree of Doctor of Philosophy conferred?

The degree of Doctor of Philosophy and Master of Arts is conferred upon candidates who (after having taken their first degree) have pursued university studies, for three years, under approved conditions, have passed the required examinations and presented a satisfactory thesis. At least the last year of study must be spent in this University.

How are the Fellowships awarded?

Twenty fellowships are annually open to competition, each yielding five hundred dollars and exempting the holder from all charges for tuition. A statement of the rules governing the awards will be sent if requested. Applications for the next year must reach the University before May 1, 1886.

COLLEGE COURSES.

Is there what is commonly known as a college course?

There are seven parallel courses, by following any one of which a matriculated student may attain the degree of Bachelor of Arts. This plan combines the advantages of choice and restriction. From the variety of courses laid down, the scholar elects that which he prefers; having made his choice he finds a definite sequence of studies provided for him. The University marks out for those who elect a classical course, such a plan for the reading of Latin and Greek authors, sometimes with a teacher and sometimes privately, as will enable all who follow it to excel in these studies, while it requires that they should also learn to read French and German, and pursue during one year a course in science. It likewise provides a training which is mainly scientific, enabling the student to concentrate his attention chiefly on Chemistry, or Biology, or Mathematics, or Physics; but with these studies he must combine the study of Languages, History, and Philosophy.

Every matriculated student is expected to follow, under the guidance of an adviser to whom he is specially assigned, one of these prescribed courses which are fully described in the Register. Some elect the classical course. Others may concentrate their main attention upon the higher branches of Mathematics. Courses are arranged also for those who wish to devote themselves chiefly to Chemistry and Physics. For those who expect at a later day to take up the study of medicine, there is a special course marked out, in which Biology is the dominant subject. Arrangements are also made in other courses for the study of History and Political Science and of the Modern Languages and Literatures.

What is required for admission to the College Courses?

Undergraduates who wish to enter, either as matriculates, candidates for matriculation, students in the preliminary medical course, or as special students, must begin by satisfying the University that they have been thoroughly taught the English studies which are usual in good high schools, academies, and private schools, including a knowledge of Arithmetic (with the metric system); Geography, physical and political; the outlines of the History of the United States; English grammar and composition. The candidate for matriculation must also pass an examination in:—

1, Latin; 2, Greek, (or French and German); 3, Mathematics (Algebra, Geometry, Trigonometry, Analytical Geometry); 4, English; 5, History; 6, Natural Science. Those who do not intend to follow the classical course may offer French and German instead of Greek. A student may be admitted, under certain circumstances, without matriculation.

Can a student be aided in completing his studies for matriculation?

If a student at his admission passes in a considerable part of the matriculation requirements, he may postpone the remainder for a time. If he is well up in Algebra and Geometry, he may join the university classes in Trigonometry and Analytical Geometry; if he is a good scholar in Latin and Greek but has not read all the authors requisite for matriculation, he may receive instruction in these authors from the University; if he has not already acquired the elements of French and German, he will be aided in doing so, in order that he may enter the courses here provided.

When will the next examinations be held?

Examinations for admission will begin Thursday, October 1, at 9 a. m. Those who pass the preliminary examination in English studies acceptably will be subsequently examined in such of the other studies as they are ready to offer.

For further information consult the Annual Register of the University for 1884-85.

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I. **American Journal of Mathematics.**
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II. **American Chemical Journal.**
I. REMSEN, Editor. Bi-monthly. 8vo. Volume VII in progress. $3 per volume.

III. **American Journal of Philology.**
B. L. GILDERSLEEVE, Editor. Quarterly. 8vo. Volume VI in progress. $3 per volume.

IV. **Studies from the Biological Laboratory.**
Including the Chesapeake Zoölogical Laboratory. H. N. MARTIN, Editor, and W. K. BROOKS, Associate Editor. 8vo. Volume III in progress. $5 per volume.

V. **Studies in Historical and Political Science.**
H. B. ADAMS, Editor. Monthly. 8vo. Volume III in progress. $3 per volume.

VI. **Johns Hopkins University Circulars.**
Containing reports of scientific and literary work in progress in Baltimore. 4to. Vol. I, $5; Vol. II, $3; Vol. III, $2; Vol. IV in progress. $1 per year.

VII. **Annual Report.**
Presented by the President to the Board of Trustees, reviewing the operations of the University during the past academic year.

VIII. **Annual Register.**
Giving the list of officers and students, and stating the regulations, etc., of the University. *Published at the close of the academic year.*

Communications in respect to publications may be sent to the Johns Hopkins University (Publication Agency), Baltimore, Maryland.

The Johns Hopkins University Circulars are printed by Messrs. JOHN MURPHY & CO., 182 West Baltimore Street, Baltimore, from whom single copies may be obtained. They may also be procured from Messrs. CUSHINGS & BAILEY, No. 262 West Baltimore Street, Baltimore.

JOHNS HOPKINS UNIVERSITY CIRCULARS

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CALENDAR, 1885–86.

1885, Thursday, October 1.	**Academic Year Begins.—Examinations for Admission (9 a. m.).**
" Thursday, December 24—Saturday, January 2.	**Christmas Recess.**
1886, Monday, February 22.	**Commemoration Day.**
" Friday, April 23—Monday, April 26.	**Spring Recess.**
" Tuesday, June 15.	**Term of Instruction Closes.**

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[Issued, July 20, 1885.]

STANDING ANNOUNCEMENTS.

JOHNS HOPKINS UNIVERSITY.

Opened for Instruction in 1876.

The Johns Hopkins University was founded by the munificence of a citizen of Baltimore, Johns Hopkins, who bequeathed the most of his large estate for the establishment of a University and a Hospital. It was intended that these institutions should coöperate in the promotion of medical education. The Hospital buildings are approaching completion.

The foundation of the University is a capital, in land and stocks, estimated in value at more than $3,000,000; the capital of the Hospital is not less in amount.

The University was incorporated under the laws of the State of Maryland, August 24, 1867. Power to confer degrees was granted by the Legislature in 1876.

Suitable buildings have been provided in Baltimore at the corner of Howard and Little Ross Sts., and are furnished with the necessary apparatus and books.

ACADEMIC STAFF, 1884–5.

Daniel C. Gilman, LL. D., *President of the University.*
J. J. Sylvester, F. R. S., D. C. L., *Professor (Emeritus) of Mathematics.*
Basil L. Gildersleeve, PH. D. LL. D., *Professor of Greek.*
G. Stanley Hall, PH. D., *Professor of Psychology and Pedagogics.*
Paul Haupt, PH. D., *Professor of the Shemitic Languages.*
H. Newell Martin, DR. SC., A. M., F. R. S., *Professor of Biology and Director of the Biological Laboratory.*
Charles D. Morris, A. M., *Collegiate Professor of Latin and Greek.*
Simon Newcomb, LL. D., *Professor of Mathematics and Astronomy.*
Ira Remsen, M. D., PH. D., *Professor of Chemistry and Director of the Chemical Laboratory.*
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William H. Welch, M. D., *Professor of Pathology.*
John S. Billings, M. D., *Lecturer on Hygiene.*
Hiram Corson, A. M., LL. D., *Lecturer on English Literature.*
Edmund Gosse, *Lecturer on English Literature.*
George S. Morris, A. M., PH. D., *Lecturer on the History of Philosophy.*
Léonce Rabillon, BACH. ÈS LETT., *Lecturer on French Literature.*
William Thomson, LL. D., *Lecturer on Molecular Dynamics.*
Herbert B. Adams, PH. D., *Associate Professor of History.*
Maurice Bloomfield, PH. D., *Associate Professor of Sanskrit.*
William K. Brooks, PH. D., *Associate Professor of Morphology and Director of the Chesapeake Zoölogical Laboratory.*
Thomas Craig, PH. D., *Associate Professor of Applied Mathematics.*
A. Marshall Elliott, A. M., *Associate Professor of Romance Languages.*
J. Rendel Harris, A. M., *Associate Professor of New Testament Greek and Palaeography.*
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Minton Warren, PH. D., *Associate Professor of Latin.*
George H. Williams, PH. D., *Associate Professor of Mineralogy.*
Henry Wood, PH. D., *Associate Professor of German.*
William Hand Browne, M. D., *Librarian and Associate in English.*
William T. Councilman, M. D., *Associate in Pathology.*
Richard T. Ely, PH. D., *Associate in Political Economy.*
Fabian Franklin, PH. D., *Associate in Mathematics.*
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Edward H. Keiser, PH. D., *Assistant in Chemistry.*
Charles A. Perkins, PH. D., *Assistant in Physics.*
Hugh Newell, *Instructor in Drawing.*
Charles L. Woodworth, Jr., *Instructor in Elocution.*
Otto Lugger, *Curator of the Biological Museum.*

PLAN OF THE CIRCULARS.

The Johns Hopkins University Circulars are published at convenient intervals during the academic year for the purpose of communicating intelligence to the various members of the University in respect to work which is here in progress, as well as for the purpose of promulgating official announcements from the governing and teaching bodies. During the current academic year, eight circulars will be issued in successive months, to be followed at the close of the year by an index.

Although these circulars are designed for the members of the University, they have frequently been called for by institutions and libraries at a distance, and also by individuals who are interested in the literary and scientific activity of this University. Subscriptions and exchanges are therefore received.

TERMS OF SUBSCRIPTION.

For the current year, 1884–5, $1.

For the year 1883–4, (140 pp. in cloth covers), $1.50.

For the year 1882–3, (156 pp. in cloth covers), $3.

For the years 1879-82, (250 pp. in cloth covers), $5.

Subscribers to the Circulars will also receive the Annual Register and Report of the University.

All subscriptions should be addressed to the "Publication Agency of the Johns Hopkins University."

Communications for the Circulars should be sent in prior to the first day of the month in which they are expected to appear.

PUBLIC LECTURES.

Notice in Respect to the Admission of the Public.

In answer to inquiries, and in correction of some current misapprehensions, the following statements are made in respect to the public lectures given in the Johns Hopkins University.

These courses are academic lectures, designed primarily for the members of the University, and supplementary to the regular class-room work of the students.

As the members of the University rarely require the entire room, the Trustees have taken great pleasure in inviting other persons, not connected with the University, to attend.

As these lectures are not intended for popular entertainment, but for the instruction of students, those persons first receive tickets, in most cases, who are known to be especially interested in a particular course,—ladies as well as gentlemen.

There is no general course ticket issued. Applications should state specifically the course for which tickets are desired. Programmes and other current information pertinent to university work may be found in the *University Circulars*, sent to subscribers, on the payment of one dollar per annum, by the Publication Agency of the University.

The usage of giving personal notification has been discontinued, and those therefore who are interested in such announcements should hereafter consult the *Circulars*.

It will save much delay if applications for tickets and inquiries on these and other routine matters are addressed not to individuals but to the Johns Hopkins University, *by postal card*, and answers will be promptly returned by mail. Personal applications consume time needlessly.

☞ The lectures begin at 5 o'clock *punctually.* The doors of the hall are opened at fifteen minutes before 5, and the lectures do not exceed an hour in the delivery.

PUBLICATIONS ISSUED UNDER THE AUSPICES OF THE UNIVERSITY.

I. American Journal of Mathematics.

The publication of this journal commenced in 1878, under the editorial direction of Professor Sylvester, and is now conducted by Professor Simon Newcomb as Editor, and Dr. T. Craig as Associate Editor. Seven volumes of about 400 pages each have been issued, and the eighth is in progress. It appears quarterly, in the quarto form. Subscription $5 per year. Single numbers $1.50.

II. American Chemical Journal.

This journal was commenced in 1879, with Professor Remsen as editor. Six volumes of about 450 pages each have been issued, and the seventh is in progress. It appears bi-monthly. Subscription $3 per year. Single numbers 50 cts.

III. American Journal of Philology.

The publication of this journal commenced in 1880, under the editorial direction of Professor Gildersleeve. Five volumes of about 570 pages each have been issued, and the sixth is in progress. It appears four times yearly. Subscription $3 per volume. Single numbers $1.00.

IV. Studies from the Biological Laboratory.

[Including the Chesapeake Zoological Laboratory.]

The publication of these papers commenced in 1879, under the direction of Professor Martin, with the assistance of Dr. W. K. Brooks. Two volumes of about 500 pages, octavo, and 40 plates each, have been issued, and the third is in progress.

V. Studies in Historical and Political Science.

The publication of these papers was begun in 1882, under the editorial direction of Dr. H. B. Adams. A first series of 470 pages and a second of 630 pages are now completed, and a third series is in progress. Subscription $3 per volume.

The following publications are also issued by the University:

The University Circulars. Subscription $1 per year.

The Annual Report presented by the President to the Board of Trustees reviewing the operations of the University during the past academic year.

The Annual Register giving the list of officers and students and stating the regulations of the University. Published at the close of the academic year.

The University Circulars, Annual Report, and Annual Register will be sent by mail for one dollar per annum.

Studies in Logic. By members of the Johns Hopkins University. C. S. Peirce, Editor. (Boston: Little, Brown & Co.) 1883. 123 pp., 12o. $2.

The Development and Propagation of the Oyster in Maryland By W. K. Brooks. 1884. 193 pp., 4o. 13 plates and 3 maps. $5.

On the Mechanical Equivalent of Heat. By H. A. Rowland. 1880. 127 pp., 8o. $1.50.

New Testament Autographs. By J. Rendel Harris. 1882. 54 pp., 8o. 4 plates. 50 cents.

Sir William Thomson's Lectures on Molecular Dynamics. Delivered at the Johns Hopkins University in October, 1884. Reproduced from stenographic notes by the papyrograph plate process. 370 pp., 4o. $5.00.

All communications in respect to publications should be addressed to the "Publication Agency of the Johns Hopkins University," Baltimore, Maryland.

NOTES ON SIR WILLIAM THOMSON'S RECENT LECTURES ON MOLECULAR DYNAMICS.[*]

By PROFESSOR GEORGE FORBES, F. R. S.

[Reprinted from *Nature*, London, Nos. 803, 805, 809—March-April, 1885, with brief additional notes by the stenographer, A. S. HATHAWAY].

I.

I have placed the three titles with this article not because I intend to deal with more than the last, but because they all deal with the same matter, and show how much the author's attention was directed to the subject during his three months' sojourn in America. The audience at the Baltimore lectures consisted chiefly of American professors, and a few English men of science attended a larger or smaller number of the lectures.

Speculation was rife as to the probable character of the lectures, and there was a general feeling that vortex motion would be largely dealt with. This, however, was not so. The course of twenty lectures was confined to the wave theory of light, largely dealing with the difficulties of that theory. The published lectures are not printed, but "jelligraphed," as Sir William Thomson would say.[†] The number of copies is extremely limited, and are of unique interest, being reproduced from the short-hand notes taken at the lectures. Every one who knows how suggestive Sir William's lectures are and how fertile his mind is in bringing illustrative digressions to bear on the topic in hand, will expect these verbatim notes to be a rare treasure. Nor will he be disappointed. Mr. Hathaway, the reporter, has the unusual combination of being an expert stenographist, a skilful mathematician, and a clear and distinct caligraphist. His notes contain numerous errors, such as are unavoidable in such an undertaking, but, viewed as a whole, his work is almost a marvel.

The lectures treated of three branches of the subject: (1) the propagation of a disturbance through an elastic medium; (2) the character of molecular vibration; and (3) the influence of molecules on the propagation of waves. Each lecture generally dealt with two of these branches, and between the two parts of the lecture Sir William went among his audience and had some conversation with them. It was ever his object to discard the professorial attitude and give his lectures the aspect of conferences. Discussion did not end in the lecture-room, and the three weeks at Baltimore were like one long conference guided by the master mind. It is not surprising that at the end of that time there was a genuine feeling of sadness at parting on the part of teacher and taught alike.

The part of the lectures dealing with the propagation of an elastic disturbance could not be expected to contain much novelty, but it was treated in so novel a manner and from so purely a physical point of view, that it could not but be instructive. Many of the old supporters of the theory dealt with it purely from a mathematical point of view. They treated the problem as a mathematical exercise, and did not hesitate to make unwarranted assumptions to produce pretty formulas or simple solutions. Even such men as Weber (in his "Theory of Magnetism") and Green (in his "Wave Theory") have been guilty of this practice. Sir William Thomson never made any but physical assumptions, and these were made for reasons given. Rather than make a meaningless mathematical assumption he would prefer to burden his formulas with undetermined quantities, and even, if unable to reach the final solution, would rejoice in the richness of the formulas, which showed a potentiality of overcoming many difficulties. He does not always commend Rankine's mathematics, but he says this for him at p. 185: "Rankine did a great deal to cure the mathematical disease of *aphasia* from which we suffered so long. Faraday did most. The old mathematicians used neither diagrams to help people to understand their work, nor words to express their ideas. It was formulas, and formulas alone. Faraday was a great reformer in that respect with his language of 'lines of force,' &c. Rankine was splendid in his vigor and in the grandeur of his Greek derivations." This refers to Rankine's nomenclature of different kinds of moduluses and their reciprocals—*e.g. plagiotatic, thlipsinomic*, &c.

The first lecture is a summary of what is to come, and is partly historical. The difficulties in the way of accepting the wave theory of light are clearly pointed out. These are four in number.

First Difficulty: Dispersion.—The difficulty is to explain how velocity of propagation depends on period of vibration. Two explanations have been offered, that of Cauchy and that of Helmholtz. He does not delay much with Cauchy, who ascribed it to heterogeneousness. He prefers Helmholtz, who ascribes it to a compound structure of material molecules, which gives them a natural period of vibration. The one explanation has relation to wave-length, the other to period of vibration. The latter, he thinks, falls in better with results of spectrum analysis, &c. A great portion of the lectures is devoted to expanding the notion of Helmholtz. The space occupied by a molecule must be filled with a substance differing from the ether either in rigidity or in density, or both. Lord Rayleigh has taken in hand this question in his researches on blue sky, and it seems that a variation of density is the principal or only effective cause. With respect to the new (Helmholtz-Thomson) spring and shell molecule, he says, "It seems to me that there must be something in this, that this, as a symbol, is certainly not an hypothesis, but a certainty."

Second Difficulty: The Ether.—He makes short work of the difficulty of reconciling almost perfect rigidity with almost perfect mobility. It is merely a matter of time. You can make a tuning-fork of Burgundy pitch when the period is a small fraction of a second, but a bullet will pass by its weight through several inches of it in six months. The ether may be highly elastic for vibrations executed in the 100 or 1600 million millionth of a second, but highly mobile to bodies going through it at the rate of twenty miles a second.

Third Difficulty: Refraction and Reflection.—Theoretical equations agree qualitatively with facts, but there are serious discordances when we come to quantitative measurements. Especially is this the case in the completeness of extinction of the ray polarized by reflection.

Fourth Difficulty: Double Refraction.—It is found that when the medium is displaced during wave-propagation in a double refracting crystal, the return force must depend on the direction of vibration, not on the plane of distortion, as all elastic theories indicate. Rankine and Rayleigh independently invented unequally loaded molecules which overcome the difficulty, but give a wave surface different from Huyghens', and Stokes has proved experimentally that Huyghens' construction is very accurate. Hence this way of escape is denied to us.

In treating of the propagation of waves in an isotropic (and later in an aeolotropic) medium, methods of Thomson and Tait's Natural Philosophy, and his own article, "Elasticity," in the "Encyclopædia Britannica," are used; $a\,b\,c$ are distortions about Ox, Oy, and Oz, $e\,f\,g$ are dilatations along Ox, Oy, Oz. The equation of the energy E is a quadratic in $a\,b\,c\,e\,f\,g$, containing twenty-one coefficients, some of which are annulled by isotropy.

If

$$P=\frac{dE}{de},\ Q=\frac{dE}{df},\ R=\frac{dE}{dg};$$

$$S=\frac{dE}{da},\ T=\frac{dE}{db},\ U=\frac{dE}{dc},$$

and if ρ be the density, and ξ a displacement along $O\,x$, we obtain the equation

$$\rho\frac{d^2\xi}{dt^2}=\frac{dP}{dx}+\frac{dU}{dy}+\frac{dT}{dz}.$$

---

[*] "On Molecules," the Presidential Address to Section A of the British Association, August, 1884, by Sir William Thomson.

"The Wave Theory of Light," a Lecture delivered by Sir William Thomson at Philadelphia on Sept. 29, 1884, published in *Nature*, Vol. XXXI, p. 91.

"Lectures on Molecular Dynamics," by Sir William Thomson, Johns Hopkins University, October, 1884.

[†] As the papyrograph process which was employed for printing the lectures does not seem to be understood, a brief explanation of it seems desirable. A transparent paper plate is used; the copyist writes upon this with a chemical ink which is almost colorless, using a very fine steel pen. The work of the copyist must be revised and corrected before the ink eats through so as to form a stencil of the writing. When the stencil is formed, a prepared purple ink which flows readily is forced by means of an impression pad through the stencil. In printing the lectures, about 300 impressions were obtained from each stencil before it began to "break" so as to be useless.

The nature of the process, and the fact that the work had to go through the hands of a copyist, will explain, I think, why so many errors have occurred which to a mathematician are virtually *typographical* errors. The reader of the lectures will also see how pages 210, 252 were thus readily traced from Sir Wm. Thomson's handwriting by means of the transparent stencil sheet. A. S. H.

Moreover, if n be the rigidity modulus, k the bulk modulus, δ the cubic dilatation, and $m = k + \frac{1}{3} n$, we have

$$P = (m - n)\,\delta,$$

$$T = n\left(\frac{d\xi}{dz} + \frac{d\zeta}{dx}\right),$$

with similar expressions for Q, R, S, U.

Thence he shows that the equations

$$\rho\,\frac{d^2\xi}{dt^2} = m\,\frac{d\delta}{dx} + n\,\nabla^2\xi, \text{ etc.,}$$

(with the condition $\frac{d\xi}{dx} + \frac{d\eta}{dy} + \frac{d\zeta}{dz} = 0$ in an incompressible substance), contain every possible solution, and he proceeds to discuss special cases of the general solution which may be true of waves propagated by molecules through the ether. Here his desire for physical conceptions appears, and his hatred of mathematical *aphasia*. He considers the case of a ball moving to and fro, of a ball twisting about an axis, of a globe becoming alternately prolate and oblate, of a rod twisted in opposite directions at the two ends, and of the Thomson-Helmholtz molecule, which is a heavy mass connected by massless springs with a massless inclosing shell, or there may be several shells inclosing each other, connected by springs with a dense mass in the centre (far more dense than the ether).

Here he discusses the manner in which a molecule may be supposed to give off its vibrations to the ether. Does it gradually increase in intensity and gradually die out, or how does it act? Here is what he says on this much-neglected point at p. 94:

"The kind of thing that the luminous vibrator consists in seems to me to be a sudden initiation of a set of vibrations and a sequence of vibrations from that initiation which will naturally become of smaller and smaller amplitude. . . . Why a sudden start? Because I believe that the light of the natural flame or of the arc light or of any other known source of light must be the result of sudden shocks from a number of vibrators. Take the light obtained by striking two quartz pebbles together. You have all seen that. There is one of the very simplest sources of light. . . . What sort of a thing can the light be that proceeds from striking two quartz pebbles together? Under what circumstances can we conceive a group of waves of light to begin gradually and to end gradually? You know what takes place in the excitation of a fiddle-string or a tuning-fork by a bow. The vibrations gradually get up from zero to a maximum, and then, when you take the bow off, gradually subside. I cannot see anything like that in the source of light. On the contrary, it seems to me to be all shocks—a sudden beginning and gradual subsidence."

The light coming from a single shock is, of course, polarised always in the same direction. Sellmeier's deductions from Fizeau's experiment shows that there is no serious fading in 50,000 vibrations. Helmholtz introduces viscous terms which absorb the energy and might prevent the possibility of 50,000 vibrations from one shock. That is a retrograde step. Absorption can be explained without viscous terms.

Such speculations, when coming from one of less grasp of physical facts, would attract but little attention. But here all kinds of useful suggestions are continually thrown out for experiment and for hypotheses. He is striving to get at the physical meaning of radiation, absorption, anomalous dispersion, fluorescence, and phosphorescence, and here is what he says on some of these points at p. 90:—

"But there are cases in which we have that tremendous jangling, and that is in the fluorescence of such a thing as uranium glass, which lasts for several seconds after the exciting light is taken away, and then again in phosphorescence that lasts for hours and days. There have been exceedingly interesting beginnings in the way of experiments already made, but I think no one has found whether initial refraction is exactly the same as permanent refraction. For this purpose we might use Becquerel's phosphoroscope, or we might take such an appliance as Prof. Michaelson has been using for light, and get something enormously more searching than Becquerel's phosphoroscope, and try whether, in the first hundredth of a second, there is any indication of a different wave-velocity from that which you would have when white light passes continuously in the usual manner of refraction. If in the methods employed for ascertaining the velocity of light in a transparent body . . . we apply a test for an instantaneous refraction, I have no doubt we shall get negative results, but yet properties of ultimate importance. We might take bodies in which, like uranium glass, the phosphorescence lasts only a few thousandths of a second; and then, again, bodies in which phosphorescence lasts for minutes and hours. With some of these we should have anomalous dispersion, gradually fading away after a time. I should think that, by experimenting, and so on, we should find some very interesting results of this kind."

In his mathematics he suppresses the condensational wave, and, in doing so, makes reference to the electro-magnetic theory of light, which, he thinks, has added nothing to our physical conceptions of the ether. In treating, further on, of reflection and refraction, he speaks a great deal of the pressural wave, which many authors have called a condensational wave. I find that in some points my notes are fuller than the reporter's. I cannot find there the following characteristic passage about the pressural wave:— "People have tried to muddle this. The pressural wave has been the difficulty. Cauchy starved the animal, M'Cullagh and Neumann didn't know of its existence, Haughton put it in an Irish car and it wouldn't go, Green and Rayleigh treated it according to its merits." *

With regard to the possibility of a condensational wave, and to the electro-magnetic theory of light, we find, on pp. 40–41:—

"We ignore this condensational wave in the theory of light. We are sure that its energy, at all events, if it is not null, is very small in comparison with the luminiferous vibrations we are dealing with. But to say that it is absolutely null would be an assumption we have no right to make. When we look through the little universe that we know, and think of the transmission of electrical force and of the transmission of magnetic force, and of the transmission of light, we have no right to assume that there is not something else that our philosophy does not dream of. We have no right to assume that there may not be condensational vibration in the luminiferous ether. We only do know that any vibrations of this kind which are excited by the reflection and refraction of light are certainly of very small energy compared with the energy of the light from which they proceed. The fact of the case as regards reflection and refraction is this: that, unless the luminiferous ether is absolutely incompressible, the reflection and refraction of light must generally give rise to waves of condensation. Waves of distortion may exist without waves of condensation, but waves of distortion cannot be reflected at the boundary surface between two mediums without exciting in each medium a wave of condensation. When we come to the subject of reflection and refraction we shall see how to deal with these condensational waves, and find how easy it is to get quit of them by supposing the medium incompressible. But it is always to be kept in mind to be examined into: Are there or are there not very small amounts of condensational waves generated in reflection and refraction; and may, after all, the electric force not depend on the waves of condensation? Suppose that we have at any place in air, or in luminiferous ether, a body that, through some action we need not describe, but which is conceivable, is alternately positively and negatively electrified: may it not be that this will be the cause of condensational waves?" It is then supposed that two spherical conductors are connected to the terminals of an alternating dynamo machine, and the quotation proceeds:—

"It is perfectly certain, if we turn the machine slowly, that in the neighborhood of the conductors we will have alternately positively and negatively electrified elements with reversals perhaps two or three hundred per second of time, with a gradual transition from negative through zero to positive, and the same thing all through space; and we can tell exactly what is the potential at each point. Now, does any one believe that, if that revolution was made fast enough, the electrostatic law would follow? Every one believes that, if that process be conducted fast enough several million times, or millions of million times per second, we should be far from fulfilling the electrostatic law in the electrification of the air in the neighborhood. It is absolutely certain that such an action as that going on would give rise to electrical waves. Now it does seem probable to me that electrical waves are condensational waves in luminiferous ether, and probably it would be that the propagation of these waves would be enormously faster than the propagation of ordinary light waves. I am quite conscious, when speaking of this, of what has been done in the so called electro-magnetic theory of light. I know the propagation of electric impulse along an insulated wire surrounded by gutta-percha, which I worked out myself about the year 1854, and in which I found a velocity comparable with the velocity of light. . . . That is a very different case from this, and I have waited in vain to see how we can get any justification of the way of putting it in the so-called electro-magnetic theory of light."

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* The passage may be found on p. 233. There are some omissions from the lectures, but only for reasons indicated by Sir Wm. Thomson either at the time in the class-room, or subsequently by letters, which have been incorporated in the report. A. S. H.

In those parts of the lectures which deal with wave propagation in an isotropic medium, by far the most interesting parts are those which treat of the conditions at bounding surfaces, whether these surfaces be reflecting and refracting surfaces or surfaces of radiating molecules, or surfaces of absorbing molecules. Lord Rayleigh's investigations and his own on the likelihood of the density or the rigidity of the substance composing a molecule differing from that of the ether are also full of interest.

Much of this part of the subject has been thoroughly worked out before, but here the treatment is so original, the language is so suggestive, and I need hardly say that the whole course of lectures is so pregnant with useful ideas, that every one who reads this part will be well repaid.

Having now roughly indicated the novel points and the general mode of treatment of the problem in *molar* dynamics, I propose in the next notice to give some account of the problem in *molecular* dynamics, which occupied half of the time.

II.

In the present article Sir William Thomson's spring and shell molecule will be described and its theory sketched, in so far as this has been investigated with the view of getting over some of the difficulties which surround the wave theory of light. In Helmholtz's memoir on anomalous dispersion, a sketch of such a theory was published. But this new molecule differs from that of Helmholtz in several points, chiefly in the fact that absorption is not accounted for by any viscous action in the molecule dissipating the energy of vibration into low grade heat. Most readers who have ever visited the natural philosophy lecture-room in Glasgow University will recognize a very old friend in this new molecule, where they have seen it vibrating, I suppose, any time since the University occupied its present site. In appearance the molecule has been changed, but its theory as taught to the students there is identical. For a description of this molecule let us refer to page 10 of the lectures:—

"Imagine for a moment that we make a rude mechanical model. Let this be an infinitely rigid spherical shell; let there be another absolutely rigid shell inside of that, and so on, as many as you please. Naturally we might think of something more continuous than that, but I only wish to call attention to a crude mechanical explanation possibly of the effects of dispersion. Suppose we had luminiferous ether outside, and that this hollow space is of very small diameter in comparison with the wave length. Let zig-zag springs connect the outer rigid boundary with boundary number two. I use a zig-zag, not a spiral, spring which has the helical properties which we are not ready for yet, such properties as sugar and quartz have in disturbing the luminiferous vibrations. Suppose we have shells two and three also connected by a sufficient number of zig-zag springs, and so on; and let there be a solid nucleus in the centre with spring connections between it and the shell outside of it. If there is only one of these interior shells, you will have one definite period of vibration. Suppose you take away everything except that one interior shell; displace that shell and let it vibrate. The period of its vibration is perfectly definite. If you have an immense number of such shells with movable molecules inside of them, distributed through some portion of the luminiferous ether, you will put it into a condition in which the velocity of propagation of the wave will be different from what it is in the homogeneous luminiferous ether. You have what is called for, viz. a definite period; and the relation between the period of vibration in the light considered and the period of the free vibration of the shell will be fundamental in respect to the attempt of a mechanism of that kind to represent the phenomena of dispersion.

"If you take away everything except the one shell, you will have almost exactly, I think, the view of Helmholtz's paper—a crude model as it were of what Helmholtz makes his paper on anomalous dispersion. Helmholtz, besides that, supposes a certain degree or coefficient of viscous resistance against the vibration of the inner shell, relatively to the outer one. Helmholtz does not reduce it to a gross mechanical form like this, but merely assumes particles connected with the luminiferous ether and assumes a viscous motion to operate against the motion of the particles."

In the lectures the action of such a molecule when subjected to forced vibrations was illustrated by a model of ingenious construction, which among the irreverent passed by the name of the "wiggler." A steel wire was hung vertically, and five or six lathes 2 feet long and 2 inches wide were attached in a horizontal position to the wire, each one having three pins fixed in it for this purpose. These lathes were loaded at their ends, the weight on each lathe being less than that on the one above it. The lowest lathe was attached to a pendulum arrangement which impressed forced vibrations upon the system, the period being adjustable. The theory of such a system is the same as that of the molecule described above.

But in working out the theory a third type of vibrator was used, the identical one which vibrates in the lecture room at Glasgow. This is a series of weights attached to each other by vertical springs which can be stretched. The highest is the heaviest, and the others are arranged in the order of weight.

Calling *P* the lathe with forced vibrations (corresponding to the external massless shell acted on by the ether) and ξ its displacement, m_1, m_2, &c., are the successive masses, x_1, x_2, &c., are their displacements

$$u_2 = -\frac{c_2 x_1}{x_2},$$

and measures the relative displacement of m_1 and m_2. c_1, c_2, &c., are the constants of successive spring connections. $c_2(x_1 - x_2)$ is the force of restitution in virtue of the spring connection between x_1 and x_2. τ is the period of forced vibration.

We thus arrive at the equation

$$\frac{du_i}{d\tau} = -\frac{2}{\tau^3}\cdot\frac{1}{x_i^2}(m_i x_i^2 + m_{i+1}x_{i+1}^2 + \dots + m_j x_j^2),$$

and since the right hand member is essentially negative, it follows that all the *u*'s diminish with increase of period. The critical cases occur when the period of forced vibration agrees with the natural period of any of the shells or lathes. When the forced vibration is very rapid, all successive masses move in opposite directions. When the forced period is slower, u_1 becomes zero, and x_1 is infinite—*i.e.*, the vibration of the lowest mass is infinite in comparison with the forced vibrator, and so with the other vibrators. When the forced period is slower, u_1 becomes negative, *i.e.*, the lowest mass begins to vibrate in the same direction as the forced vibrator. Successive critical cases occur as the forced period reaches the natural periods of successive vibrators. At the critical period for any one vibrator, all those below it are vibrating in one direction, while the critical one and those above it are executing very large vibrations in opposite directions successively.

These critical periods are admirably adapted for explaining absorption and also anomalous dispersion. In highly absorbing media which cut off a band of light from the spectrum, the refractive index for colors neighboring to the band is remarkable; thus light of greater wave-length than the band is refracted more, and light of less wave-length than the band is refracted less than in normal substances. Lord Rayleigh considered this to be due to the mutual influence of the vibrating molecule and ether. If the point of support of a pendulum is vibrated in a different period, the period of the pendulum is changed. Lommel seems to have been the first to make dispersion depend upon associated matter.

The influence of a large number of the spring and shell molecules distributed through the ether upon the velocity of light in that medium is examined and shown to depend upon the wave-length or period. Finally at p. 108 we obtain the following formula:

$$\frac{\tau^2}{\lambda^2} = \frac{1}{l}\left[\rho - c_1\tau^2\left\{1 + \frac{c_1\tau^2}{m_1}\left(\frac{\kappa_1^2 R_1}{\kappa_1^2 - \tau^2} + \frac{\kappa_2^2 R_2}{\kappa_2^2 - \tau^2} + \dots\right)\right\}\right]$$

ρ and l measure the density and rigidity.

$$R_i = \frac{\text{Energy of 1st shell } m_1}{\text{Energy of the whole.}} \text{ for } \tau = \kappa_i$$

κ_i = the ith critical period.[*]

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[*] The critical periods denoted by κ_i are the roots of $\frac{\xi}{x_1} = 0$ or $u_1 = 0$. Vibrations of the molecule in those periods can evidently communicate no motion to the surrounding ether, for $\xi = 0$ for finite values of x_1. On the contrary, if ξ has an actual value in one of these periods x must be infinite. In other words, the energy of motions of the ether in these periods is infinitely rapidly absorbed into the molecule. An example mentioned by Sir Wm. Thomson is to vibrate a watch in the period of its hair spring; the balance wheel will soon vibrate enormously and break. Sir Wm. Thomson said on this point before he introduced the mathematical analysis of the subject (p. 37): "If you want to hurry up a particle (or a swing, for example) you shove it at the end of one

4. Prose Composition.

   Gasc's Prose Composition, *first half-year;* Original Essays, *second half-year. Weekly.*

5. Lectures on Classical French Literature, *first half-year,* on Early French Literature, *second half-year.*

   Weekly. Dr. Todd.

II. Special Courses in Italian and Spanish.

1. Italian. Dr. Todd.

   (*a*) *Literary Course.* Massimo d'Azeglio: *Nicolò de' Lapi;* Alfieri: *Filippo;* Goldoni: *Gl' Innamorati;* Dante: *Inferno. Weekly.*
   (*b*) *Historical Course.* Machiavelli: *Il Principe;* Sonzogno's *Storia della letteratura italiana. Weekly.*
   (*c*) *Grammar and Composition. Weekly.*

2. Spanish. Dr. Todd.

   Selections from "Fernan Caballero," José Selgas, Lafuente, Javier de Burgos, Juan Valera, Emilio Castelar. Knapp: *Spanish Grammar and Readings, first half-year.* Calderon: *El Mágico Prodigioso;* Cervantes: *Don Quijote; El Poema del Cid, second half-year. Twice weekly.*

III. Advanced Courses in Romance Philology.

The work in Romance Philology for properly qualified students extends through three years. It is intended primarily for Graduate Students and is specially adapted to the training of teachers and specialists. Students who enter for the later years of the course must show that they are acquainted with the subjects previously studied, and those who begin the course must show that they are familiar with Latin, Modern French and German.

Mr. Elliott will give the following courses:

1. With first year graduate students.

   First Half-Year: (*a*) The reading of Old and Middle French, Old Provençal, Italian, Spanish and Portuguese texts.

   For the French, Bartsch's *Chrestomathie de l'ancien Français* and Darmesteter et Hatzfeld's *Morceaux Choisis* will be used, for Old Provençal, Bartsch's *Chrestomathie Provençale. Weekly.*

   (*b*) Lectures on Modern French Phonology.

   Weekly.

   Second Half-Year: The continuation of Old French and Provençal with the addition of

   (*c*) Introduction to Old French Philology.

   Aucassin et Nicolète (Suchier's edition). *Weekly.*

   (*d*) Wallachian.

   Weekly.

2. With second year graduate students.

   (*a*) Old French Seminary (two hours); Lectures on Comparative Romance Morphology and Langue d'Oïl Dialects (original texts and practical exercises).

   Weekly, through the year.

   (*b*) The History of Romance Studies in Europe.

   Weekly, first half-year.

3. With third year graduate students.

   The Seminary work will centre here in the *Vie de Saint Alexis,* from which the student will pass to a study, for two hours weekly during the year, of the early Franco-Norman Dialect in its relations to the Anglo-Norman and to the Ile-de-France species.

   First Half-Year: The Italian and Spanish Dialects and Old French Syntax.

   An important feature of the former of these courses, will be the reading of original texts and the tracing of their phonetic and morphological relations to the Classic and Low Latin and to the leading literary types of to-day. For the Syntax, Old French is made the basis of work simply to have a convenient point of departure with which students have become more or less familiar in the first two years of their university training. Constant comparison is kept up from the beginning of the course with Latin word-relation and that of the earlier stages of the other leading Romance Languages. *Weekly.*

   Second Half-Year: Romance Palæography and Low Latin.

   The first course here will be carried out with fac-similes of French, Italian and Spanish MSS.; the second will also consist in the reading of texts as given in Paul Meyer's *Recueil d'anciens textes bas latins,* a critical examination of a part of the Probi appendix, as published in the same work, and of the Reichenau Glosses, as given in Förster and Koschwitz' *Altfranzösisches Übungsbuch. Weekly.*

WORK OF THE PAST YEAR, 1884-85.

Greek.

Under the direction of Professor Gildersleeve the advanced students of Greek have been organized into a Greek Seminary. According to the plan of the seminary, the work of each year is concentrated on some leading author or some special department of literature. During the past year the work has been in the Attic Orators.

In the seminary proper, which met twice a week during the academic year, the orators chiefly studied were Antiphon, Andokides, Lysias, Isaios, and Demosthenes. Especial attention was paid to the development of language and style and to the antique canons of aesthetic criticism. The members were required to furnish in turn exegetical and critical commentaries on select portions of the orators, to make analyses of speeches and abstracts of rhetorical treatises.

Of the investigations carried on may be noted: The phraseology and syntax of the fifth oration of Antiphon, the style of Andokides' third as compared with the first and second orations, Thrasymachos of Kalchedon, comparative study of the Trapezitikos and Aiginetikos of Isokrates, synonyms in the orators, the use of the participle in Greek lyric poetry, on the language of the oracles especially in Herodotos, special studies in the vocabulary of Dionysios.

The work of the seminary was supplemented by the study, with critical exercises, under the guidance of the Director, of the rhetorical works of Dionysios of Halikarnassos, and by a course of lectures on the History of Greek Oratory.

Besides the seminary course proper, Professor Gildersleeve delivered twenty-three lectures on Greek Syntax, conducted twenty-two exercises in translating at dictation from Greek into English and English into Greek, and gave a course of twenty lectures on Lyric Poetry. He also conducted a series of sixteen conferences in Greek Grammar for undergraduates.

Mr. Harris conducted class courses in New Testament Greek (three times weekly, first half-year, and five times weekly, second half-year), and in Sub-Apostolic Literature (three times weekly through the year); and gave a course of eight public lectures on the Perpetuation of Ancient Manuscripts.

Classes were conducted by Dr. Emerson in Classical Archæology (weekly through the year), in the Attic Judicial System (weekly, second half-year), and in the History of Ancient Art (twice weekly, second half-year).

Additional courses were conducted by:

Professor C. D. Morris, in

Plato, *Gorgias, four times weekly, first half-year.*

Aeschylus, *Persae;* Euripides, *Iphigenia in Tauris, three times weekly, second half-year.*

Reading at sight.

Dr. Spieker, in

Isocrates, I, IV; Xenophon, *Hiero, four times weekly, first half-year.*

Homer, *Iliad*, XVI–XVII; Euripides, *Hercules Furens, four times weekly, second half-year.*

Classes in Greek Prose Composition were also conducted by each of the instructors in connection with the courses above named.

Students have privately read for examination the following books:

Herodotus, *Merry's Selections*, (6).
Homer, *Odyssey*, XXI–XXIV, (6).
Xenophon, *Oeconomicus*, (7).
Plutarch, *Themistocles*, *Cicero*, (6).

Latin.

The Latin Seminary, under the direction of Dr. Warren, held two sessions a week throughout the year, the authors forming the centre of work being the Roman Satirists, especially Horace and Juvenal.

Some of the Fragments of Lucilius were read and discussed, select Satires of Horace and Juvenal were interpreted by the members of the Seminary, in turn, and papers were read by them embodying the results of special studies. Among the subjects thus treated were Juvenal's use of the gerund and gerundive; words borrowed from the Greek used by Horace and Juvenal; the use of the conjunction *cum* in Juvenal; the conditional sentence in Juvenal; the *sermo familiaris* as seen in Lucilius, Horace, Persius, Juvenal, and Petronius; the use of certain suffixes in Plautus, Terence, Lucilius, Horace, Persius, and Juvenal; the future active participle in Juvenal; the position of adjectives with respect to their substantives in Horace; the so-called Sulpiciae Satira; the use of the preposition *de* in Juvenal; the differences existing between the Satires and other works of Horace; some peculiarities of the Horatian Hexameter based upon statistics collected by members of the Seminary.

In connection with the Seminary work, Dr. Warren gave a course of weekly lectures during the first half of the year on the Roman Satirists. In the latter half of the year Dr. Warren conducted a weekly course of Practical Exercises in Latin.

Additional courses have been conducted during the year by:

Dr. Warren, in

Plautus, *Mostellaria*, and Terence, *Andria, three times weekly, first half-year.*
Tacitus, *Agricola, Germania, Annals*, I, *three times weekly, second half-year.*
Reading at sight, *weekly, throughout the year.*

Professor C. D. Morris, in

Cicero, *de Oratore* I, *Tusculan Disputations* I, *three times weekly, first half-year.*
Catullus and Martial, *Select Poems, three times weekly, second half-year.*
Reading at sight, *weekly, throughout the year.*

Dr. Spieker, in

Livy, II, III, *four times weekly, first half-year.*
Horace, *Select Odes, Satires, and Epistles, four times weekly, second half-year.*

Classes in Latin Prose Composition, meeting weekly, were also conducted by each of the instructors in connection with the courses above named.

Students have privately read for examination the following books:

Cæsar, *Bellum Civile*, (9).
Cicero, *de Senectute*, (1); *de Amicitia*, (9); *Tusculan Disputations*, II, (2); *Orator*, (2).
Horace, *Epodes*, *Carmen Saeculare*, (12).
Livy, V, VI, (1).
Ovid, *Fasti*, I, II, (12); *Selections*, (1).
Plautus, *Captivi*, (3).
Pliny, *Select Letters*, (2).
Tacitus, *Agricola*, *Germania*, (1); *Histories*, I, (1); *Annals*, III, IV, (6), IV, V, (1).
Terence, *Phormio*, (3).

Shemitic Languages.

The work of the past year was essentially a continuation of the courses begun during the session 1883–84. For beginners the only course given was in elementary Hebrew. The course in the elements of Biblical Aramaean presupposed a thorough knowledge of Hebrew. The Shemitic studies again centred in the Old Testament on which at first five, and later four, lectures a week were given.

In the *Hebrew course for beginners* the essential elements of the grammar were acquired (after Gesenius-Kautzsch's Hebrew Grammar, translated by E. C. Mitchell) and then the reading of the Pentateuch was entered upon.

In the *Hebrew Exercises* about forty chapters from the historical books of the Old Testament were read at sight: Exodus, 16; Genesis, 11 and 12; Jonah, 1 and 3; Job, 1 and 2; Exodus, 3 and 4; Judges, 19 and 20; 2 Samuel, 11; Numbers, 22; Judges, 11; 1 Kings, 17; Exodus, 31 and 32; 2 Kings, 19–21; Deuteronomy, 34, and Joshua, 1–2; Nehemiah, 1 and 2; Jeremiah, 37 and 38; 1 Samuel, 13; 1 Kings, 12 and 13; 1 Chronicles, 10, and 1 Samuel, 31, and 2 Samuel, 1; 2 Samuel, 12; Judges, 6; Ruth, 1 and 2; 1 Kings, 1 and 2; Nehemiah, 8 and 9.

In the *Critical Interpretation of Selected Psalms*, Psalms 23 and 1, and especially the fifteen post-exilic so-called Songs of degrees (Ps., 120–134) Hebrew *Shîrê hamma‘alôth, i. e.*, the Songs of the Return (from exile) were thoroughly explained and critically analyzed, with special attention to textual criticism, date of authorship, and constant comparison with the ancient versions of the Psalter.

In the course in the *Elements of Biblical Aramaean* the forms were studied after the paradigm-tables in Baer and Delitzsch's edition of *Libri Danielis, Ezrae et Nehemiae* (Leipzig, 1882) and the first chapters of the book of Daniel read. This course was especially intended as a preparation for the study of Syriac.

In *Arabic* there was read the anecdote of a man of Baghdâd and his slave girl from the *Kitâb tazyîn el-aswâq* (Kosegarten's *Chrestomathia Arabica*, p. 22; Petermann, *Brevis linguae Arabicae grammatica*, p. 33; cf. Lane, *The Thousand and One Nights*, Vol. III, p. 524), and then extracts from the Travels of Ibn Baṭûṭah in the first volume of the Beyrut Arabic Chrestomathy *Majâni el-adab* (Beyrut, 1883, Imprimerie Catholique): No. 302, The sheikh Abdallah and the elephants; No. 309, The wagons in the Crimean (*Qifjaq*) Steppes; No. 313, Ibn Baṭûṭah's journey to the city of Bolgary; No. 344, Ermine and Sable; No. 320, Meteorites, and finally No. 314, Ibn Baṭûṭah's journey to China and his suffering in captivity. In addition the class met two hours weekly to read easy Arabic texts at sight, under the guidance of Dr. A. L. Frothingham, Fellow in Shemitic Languages; selections from the Chronicles of Abulfaraj, Fables, Anecdotes, etc., were read.

In *Ethiopic* the whole book of Baruch in Dillmann's *Chrestomathia Aethiopica* was explained. This was preceded by a series of lectures on the grammar of the Geez language.

In *Assyrian* a course of lectures was first given on Comparative Assyrian Grammar, after which the cuneiform account of the campaign against the Arabians in the Annals of King Sardanapalus (B. C. 668–626) was studied. This was read and explained from beginning to end (V R. 7, 82–10, 5).

In *Sumero-Akkadian* the Syllabaries and Vocabularies in the first part of Haupt's *Keilschrifttexte* were finished, besides the Akkadian Incantation No. 9 and the Sumerian Penitential Psalms No. 14 in Haupt's *Texts*, and finally the Sumero-Akkadian Family Laws (V R., 24).

All the courses were one hour a week through the year with the exception of Elementary Hebrew, Ethiopic, and Assyrian, to which in turn two hours a week were devoted.

Sanskrit and Comparative Grammar of the Cognate Languages.

During the session the following courses were conducted by Dr. Bloomfield:

1. *Elementary Sanskrit.* The most essential elements of the grammar of the classical language were acquired in as short a time as possible, and then the students were brought face to face with the language, learning its struc-

ture and laws, not in the abstract, but in its living body. This course served especially, as was found by practical experience, to furnish the students with a knowledge of grammatical analysis, clearer and more exact than that which they bring with them from other philological pursuits. This is due partly to the unrivalled transparence of the structure of the language, and partly to the tradition which has kept alive a close bond between Sanskrit and Comparative and Historical Grammar. Five books of the *Nala* and about a dozen selections from the *Hitopadeça* (both in Lanman's Reader), were read and thoroughly analyzed.

2. A second class in Sanskrit was conducted through a rapid course of reading in the *Hitopadeça* and *Kathāsaritsāgara*.

3. The advanced class in *Vedic Sanskrit* began with a short course in the *Brāhmanas*, restricting themselves to the characteristic selections in Lanman's Reader, which were thoroughly analyzed. The bulk of the year was devoted to an introduction into the *sūtra*-literature, and the relation of the *sūtras* to the hymns of the *saṁhitās*. Selections from *Āçvalāyana's gṛhya-sūtras*, including the hymns cited in them, were read, and their bearing upon Indian life and literature in general was discussed. A series of selections from the law book of *Manu* closed the work of the year.

4. A course in the *general principles of Comparative Philology* was carried on throughout the year. It was introduced by twelve lectures on the leading questions of Indo-European Comparative Grammar (*phonetic law and analogy, agglutination, the questions attaching themselves to the relationships of languages*, etc.). During the remainder of the year Professor Whitney's "Language and the Study of Language" was made the basis of instruction, but this was constantly supplemented by lectures, which aimed to advance the subjects treated in the book up to the present day.

5. A course in *Comparative Grammar of Greek*. This was devoted especially to a detailed exposition of the latest theories on *Indo-European vocalism*, and to a practical application of them to the body of the Greek language. Incidentally other important chapters of Greek Grammar, especially the *guttural series of consonants*, and *questions on accentuation*, were treated. The most important phenomena in the vocalism of the principal related languages, Latin, Gothic, and Sanskrit, were also presented.

German.

Dr. Wood conducted the following advanced courses:

Gothic. *Twice weekly, first half-year.* The selections from Ulfilas in Braune's grammar were read and explained. A historical and critical introduction to the study was given, together with four lectures on the history of the Gothic declensions, and four on Gothic syntax.

Old High German. *Weekly, first half-year, twice weekly, second half-year.* The following parts of Braune's Reader were read: Nos. 4, 5, 9, 16 (Tatian), 17 (The Strassburg Oaths), 28 (Hildebrandslied), 29, 30 (Muspilli), 31, 33, 34, 35, 36, 39, 40, 41, and part of 32 (Otfrid). Seven lectures were given on the High German Mutation of Consonants.

Middle High German. *Weekly, through the year.* Paul's Grammar (second edition) was used. Selections (about half) from Walter von der Vogelweide (Wilmann's second edition), and one third of Hartmann's *Iwein* (ed. Benecke-Lachmann) were read. Four lectures were given on Middle High German Metre.

German Comparative Grammar. (Lectures). *Weekly, second half year.*

The undergraduate classes were conducted by Dr. Wood and Mr. Hempl, as follows:

Major Course:

German Literature. Lectures. *Weekly.* DR. WOOD.

Goethe: *Hermann and Dorothea; Faust I. Twice weekly.* MR. HEMPL.

Selected Readings. Masius: *Lesebuch III. Weekly.* DR. WOOD.

Prose Composition. *Weekly.* DR. WOOD.

Exercises in German Style. *Monthly.* DR. WOOD.

Minor Course:

Lessing: *Minna von Barnhelm; Prosa.* Goethe: *Prosa.* (*Two Sections*). *Twice weekly.* MR. HEMPL.

Selected Readings. Oltrogge; *Lesebuch II.* (*Two sections*). *Twice weekly.* DR. WOOD and MR. HEMPL.

Prose Composition. *Weekly.* MR. HEMPL.

Oral Practice. *Weekly.* DR. WOOD.

A class in German conversation was conducted by Dr. Gerber daily, through the year.

Supplementary Classes:

First Section: Brandt's Grammar, Deutsch's Reader. Schiller: *Lied von der Glocke* (ed. Otis). *Three times weekly.* MR. HEMPL.

Second Section: Otis: Elementary German. Ludwig: *Schloss Heimburg. Five times fortnightly.* MR. HEMPL.

English.

Advanced courses were conducted as follows:

Anglo-Saxon: Béowulf. *Weekly.* DR. WOOD. Seven lectures on Germanic Mythology were given with this course.

Anglo-Saxon Grammar. Lectures. *Twice weekly, during March, April, and May.* DR. J. W. BRIGHT.

Additional classes, including the first and second year's courses for undergraduates were conducted as follows:

The minor (first year's) course was directed by Dr. Browne. The first half-year of this course was devoted to the Elizabethan writers. The work included a study of the period and its influences, the prose-writers, lyrists, and allegorical writers, and the rise and development of the drama. Shakespeare's *Julius Cæsar* (Clark and Wright's edition) was carefully studied as class-work. The later Elizabethan drama was illustrated by Webster's *Duchess of Malfy*, and Fletcher's *Rule a Wife*. Abbott's *Shakespearian Grammar* was recommended for reference. The second half-year was employed in the study of fourteenth century literature. Texts studied in class were Chaucer, *Nonne Prestes Tale* (ed. Morris) and Langland, *Piers the Plowman*, Passus 1–3, 5–6 (Skeat's edition), and the period was further illustrated from Wyclif, the pseudo-Chaucer, and *Pierce the Ploughman's Crede*.

The major (second year's) course included instruction in Anglo-Saxon with Mr. C. B. Wright, twice weekly, through the year; Sievers' *Grammatik*, Sweet's *Reader*, and Cynewulf's *Elene* (ed. Zupitza) were used as text-books. Mr. A. E. Egge also conducted a class in Early English, twice weekly, through the year; Skeat's *Tale of Gamelyn*, and Morris's *Specimens of Early English, Part I*, were read.

The work in English done in the P. H. E. course (required of all undergraduates) was conducted by Dr. Browne and was directed with the view of giving the matriculates a sound general conception of the whole body of English literature from the earliest times down to the present century. No manual was used, the students being brought into contact with the original texts, except in the case of writers earlier than the fourteenth century, where the examples selected for illustration were modernized by the instructor. The class read aloud, under the instructor's guidance, Chaucer's *Prologue* and *Knightes Tale* (Morris's edition), and Shakespeare's *Hamlet*. The ground covered by the course extended from *Béowulf* to Burke.

Courses of public lectures were given on:

English Poetry and on the Poet Gray, by Mr. Edmund Gosse. (8).
Shakespeare, by Professor Hiram Corson. (20).
Phonetics, by Mr. A. Melville Bell. (7).
Shakespeare Bibliography, etc., by Mr. Justin Winsor. (2).
Shakespeare (Readings), by Mr. D. C. Bell. (2).

A Shakespeare Circle was formed under the general guidance of Dr. Browne and Dr. Wood, and held several conferences through the session.

Romance Languages.

Advanced courses were conducted as follows:

The Romance Seminary, under the direction of Mr. Elliott. *Two hours a week through the year.*

The work was concentrated on three of the earliest Old French Monuments, namely, the *Cantilène de Sainte Eulalie, Fragment de Valenciennes* and part of the *Passion du Christ*. The examination of these texts was on MS. fac-similes and bore upon both matter and form. Their mixed dialect character, their phonological and morphological relations to the Classic and Low Latin, to the oldest products of the other Romance Languages, to the later Old French Documents and to the Modern French Language, formed the bulk of material with which the Seminary was occupied. In connection with the Eulalia Hymn, considerable time was spent in a study of the Latin Sequentia of the Middle Ages and of their relation to the literary forms that preceded and followed them. This course was followed by the most advanced students only. In addition to it a Seminary meeting was held once a week in which all special students of this department took part. The subjects here discussed were of a more general nature, and such as might fitly claim the attention of first year men, who thus had the benefit of direct and active association with their more experienced co-workers in the field.

Introduction to Old French Philology. *Aucassin et Nicolète* was critically studied with special reference to its phonology and morphology as compared with the Classic Latin, on the one hand, and with the Modern French, on the other. The leading characteristic forms of the dialect here represented were constantly contrasted with corresponding ones in the Ile-de-France species. *Weekly through the year.*

Wallachian:—The whole of Cionca's *Practische Grammatik der rumänischen Sprache* was worked through and short poetical extracts read from Alexandri, Alesandrescu, Muresianu and Sionu. *Weekly, second half-year.*

Lectures:—(*a*) On the Langue d'Oïl Dialects. The object of this course was to give the leading characteristics of the chief dialect groups that constitute the North French. The system followed in carrying out this idea was, first, to put before the student, in short lectures, the distinguishing traits of each dialect, and, then, to follow these with selections of texts which were translated and their dialect peculiarities pointed out by the student himself.

(*b*) The History of Romance Studies in Europe. The history of the various theories with reference to the origin and growth of the Romance Languages was succinctly given, the productions of individual scholars that have worked in the field were characterized, and the chief works, monographs, and articles of those now engaged in Romance studies were noted, and critical remarks made on their general bearing and worth for the subjects which they treat. This course was intended to put the student abreast of the present scientific production in this field. *Weekly.*

(*c*) Comparative Romance Phonology. Here an attempt was made to group together the general laws bearing upon the same subject in Romance Phonetics, to note the action of like tendencies to law in different members of the group and to classify the more important differences of phonetic development according to their genetic relations. *Weekly.*

(*d*) Modern French Phonetics. This course, together with the Introduction to Old French Philology, as given above, was intended for first year students who wished to become specialists in the Romance Languages. The student was held here to modern forms exclusively and taught to make use of scientific methods. *Weekly.*

(*e*) The History of the Past Participle in French. *Three Lectures.* These lectures were given to call the special attention of first year students to modifications in the treatment of this important grammar category, as proposed by certain modern grammarians.

The undergraduate courses were as follows:

The students of the French Major Course have read with Dr. Todd:—In Bartsch's Chrestomathie, the selections from *Les plus anciens monuments, St. Alexis, Amis et Amiles, Bestiaire de Philippe de Thaün, Mystère d'Adam, Tristran, Roman de Rou, Contes del Graal, Sermon de Saint Bernard, Roman de Renart, Roman de la Rose, Villehardouin, Froissart, Philippe de Comines, Perceforest;* and the whole of the Oxford text of the *Chanson de Roland.*

Dr. Todd has also given, in this course, seven lectures on the French Literature of the Middle Ages.

The students of the French Minor Course have read with Dr. Todd:—*Le Voyage autour de ma Chambre* by Xavier de Maistre, *Les Jumeaux de l'Hôtel Corneille* by Edmond About, *Les Mésaventures d'un Ecolier* by Töpffer, *Le Barbier de Séville* and the *Lettre critique sur le Barbier de Séville* by Beaumarchais, and *Hernani* by Victor Hugo. Twenty-minute talks on French Literature upon the basis of Saintsbury's *Primer* have been given in connection with the above readings;—With Mr. Bowen they have read 110 pp. of Montesquieu, *Grandeur et Décadence des Romains,* 75 pp. of Masson, *French Classics, Vol. VII.,* (Memoirs of 17th Century); 100 pp. of Milne-Edwards, *Précis d'Histoire Naturelle,* and in connection with this, studied 150 pp. of Breymann's *French Grammar;*—With Mr. Fontaine they have studied and prepared written exercises on the whole of Part I. and fifty *thèmes* of Part II. in Chardenal's Exercises for Advanced Pupils.

Mr. Fontaine has met the students of the Minor Course five times weekly for French conversation with systematic instruction and drill in pronunciation.

Dr. Todd has conducted special courses in Italian, Spanish, Catalan, Old Provençal, Modern Provençal, and Portuguese:—The class in Italian have read the following authors. Goldoni: *Gl' Innamorati;* Manzoni: *I Promessi Sposi* (one hundred pages); Machiavelli: *Istorie Fiorentine* (second book); selections from Leopardi; and a short *Storia della Letteratura Italiana.* Exercises in grammar have been given twice weekly in connection with the above.

The class in Spanish have read the following: Knapp's Spanish Readings (one hundred and fifty pages); *El Barómetro* (comedia); *Don Quijote* (ten chapters); and 1200 verses of the *Poema del Cid* (XII Century). Exercises in grammar have been given twice weekly.

In Catalan the *Cronaca* of Ramon Muntaner, Chapters VI. to XXVII. (Cardona's *Dell' Antica Letteratura Catalana*), was read.

In Old Provençal were read the *Poème sur Boèce;* selections from *Girart de Rossilho,* from the poetry of Marcabrun, Bernart de Ventadorn, and Peire d'Alvernhe; and all the prose of Bartsch's Chrestomathie. In Modern Provençal, three cantos of Mistral's *Mirèio* were critically studied.

The class in Portuguese have read three cantos of Camoens' *Lusiads,* and numerous selections from Braga's *Antologia Portugueza,* covering the most ancient period of the language.

Ten public lectures on Romance Literature were given in Hopkins Hall. Three of these by Dr. H. A. Todd, on *Contemporary Spanish Literature,* embraced: I, Contemporary Poetry in Spain; II, The Modern Spanish Novel; III, The Orators and Drama of Modern Spain. Seven lectures, by Associate Professor Elliott, on *Camoens,* covered: I, II, Sketch of Portuguese History to the Death of Camoens; III, Life of Camoens; IV, Minor Works of Camoens; V, VI, The Lusiads; VII, Camoens at Home and Abroad in the Nineteenth Century.

Two public courses on French Literature, including twenty-five lectures and readings (in French) were given by M. Rabillon.

The Johns Hopkins Philological Association has met monthly as heretofore. Papers have been read during the session by:

C. Adler.—On the Etymology of Elixir; Note on the Catalogue of the Books of the Bible in the MS. of the "Teaching of the Twelve Apostles."

W. M. Arnolt.—On some Oracles in Herodotus.

M. Bloomfield.—Two Etymological Notes; the probable Sanskrit Equivalent of the Greek particle *ἀρ, ῥα*; on a New Group of Vedic Words, belonging to the root *praç.*

J. M. Bright.—Some account of King Alfred's Anglo-Saxon Version of the *De Consolatione Philosophiae* of Boethius.

A. M. Elliott.—On a Philological Expedition to Canada.

A. Emerson.—On Petrarca's Relations to the Universities of his time.

A. L. Frothingham.—On the Meaning of Baalim and Ashtaroth in the Old Testament.

W. E. Gates.—Some Notes on the Elene and Cynewulf.

"This is the expression for the square of the refractive index, as it is affected by the presence of molecules arranged in that way. It is too late to go into this for interpretation just now, but I will tell you that if you take τ considerably less than κ_1 and very much greater than κ_2 you will get a formula with enough disposable constants to represent the index of refraction by an empirical formula, as it were, which from what we know, and from what Sellmeier and Ketteler have shown, we can accept as ample for representing the refraction index of most transparent substances. We have the means of extending its powers and introducing the effects of those other terms, so that we have a formula which is more than sufficient to give us a mathematical expression of the refrangibility in the case of any transparent body whose refrangibility is reliable."

In fact the above formula is equivalent to the well-known formula of Cauchy and others, viz.:

$$\mu = \mu_0 \left(A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4} + \ldots \right)$$

when we are not dealing with critical cases. Examining the formula for $\frac{\tau^2}{\lambda^2}$ or μ^2, we see that as τ approaches κ_1, μ^2 becomes infinite, and for τ a little greater than κ_1, μ^2 is negative, which is impossible, and we can have no assignable velocity for such a period—*i.e.* there is absorption for all values of $\tau > \kappa_1$, which make μ^2 negative. Moreover, owing to the existence of a critical period, κ_1, the refractive index is abnormally increased for values of τ which are just less than κ_1, and it is abnormally diminished just when μ^2 becomes positive. This means that the refrangibility of rays in a highly absorbent medium, in the neighborhood of the band of absorption, is anomalous in the direction indicated by Kundt in his researches on anomalous dispersion. Here is what we find at p. 150 on critical values of τ and the manner of absorption:—

"We shall try to see something more of the effect of light propagated through a medium of a period exactly equal κ_1. I believe each sequence of vibrations will throw in a little energy which will spread out among the different possible motions of the molecule. The combination of the sequences, forming what we call continuous light, is not a continuous phenomenon at all. I believe that the first effect when light begins will be: each sequence of waves of the exact period throws in some energy into the molecule. That goes on until, somewhere or other, the molecule gets uneasy. It takes in an enormous amount of energy before it begins to get particularly uneasy. It then moves about, and begins to collide with its neighbors, perhaps, and will therefore give you heat in the gas, if it be a gaseous molecule. It goes on colliding with the other molecules, and in that way imparting its energy to them. The energy will be simply carried away, by convection if you please, or a part of it perhaps. Each molecule set to vibrating in that way becomes a source of light, and so we may explain the radiation of heat from the molecule after it has been got into the molecule by sequences of waves of light. I believe we can so explain the augmented pressure of a gas due to the absorption of heat in it.

"We may consider, however, that the chiefest vibration of the molecule is that in which the nucleus goes in one direction, and the shell in the opposite direction, but with a great amount of energy in the interior vibrations and very little in the shell, so that the shell may go on giving out phosphorescent energy for two or three hours or days, simply vibrating for ever, except in so far as the energy is drawn off and allowed to give motion to other bodies."

A great deal more is said about the influence of critical periods upon anomalous dispersion, but, as the author says, "it is like fiddling when Rome is burning to discuss anomalous dispersion when double refraction is waiting to be explained," so I will pass from this subject.

We have in the lectures some indications of the effect of introducing a gyrostat inside the shell molecule, especially with relation to magnetic rotation of the plane of polarisation. On this subject the author said sadly: "But alas! my results give me another law, not more effect with greater frequency, but less effect with greater frequency, and according to the inverse of the wave-length.* I therefore lay it aside for the present, but with perfect faith that the principle of explanation of the thing is there," (p. 244).

But, on returning to this country, a more complete theory of the gyrostatic molecule was worked out, sent to America, and incorporated in the lectures. In my next and concluding notice I shall touch on the further developments if space permits.

III.

Before proceeding with new parts of this subject, I wish to say a few words about "fiddling while Rome is burning." Sir William Thomson writes to me that the expression was used while discussing some mathematical triviality, and he wishes to be relieved of the imputation of speaking disrespectfully of *anomalous dispersion*, which he says is quite as important as *double refraction*. I grant this, but my interpretation of his language when I heard the lecture was that so many possible ways had been shown of explaining anomalous dispersion that it was mere child's play (or fiddle-playing) to discuss it while the burning question of double refraction awaited explanation, upon which question seems to depend the whole safety of the wave-theory of light, that theory being in imminent danger of destruction therefrom.

I shall now give a brief account of the gyrostatic molecules, crude and improved. The crude one is a fly-wheel inside a massless shell. Here there is no gyrostatic action opposing a motion of translation, but only opposing a motion of rotation. This is the molecule which was stated to give the wrong kind of variation of magneto-optic rotation with variation of wave-length. The improved gyrostatic molecule (p. 320) consists of two fly-wheels on one axis. But the axis is cut in two in the middle between them, and the parts fitted together by a ball and cylinder joint. The other ends of the half axes are supported in ball-and-socket joints in the massless shell. So far as rotation of the shell is concerned, this acts like one gyrostat, the axis always remaining in one line. But if the shell be frictionless, the ether can only give translational movement to it, and the double gyrostat produces a gyrostatic effect when the molecule is accelerated in any direction except along the axis.

The special function of this molecule is to explain magneto-optic rotation of the plane of polarisation. The axis of the molecule is supposed to be the direction of the lines of force. It is required to be proved that, gyrostatic molecules being imbedded in the ether with their axes parallel and their directions of rotation the same, the velocity of propagation of a circular disturbance going with the gyrostat is greater than that of a circular disturbance in the opposite direction. With a steady propagation of circularly polarised light, the gyrostats will clearly execute a precessional motion. The theory of this motion is examined after the manner of Thomson and Tait's "Natural Philosophy" for a ray along the axes, and the gyrostatic effect is found to be equivalent to altering the effective density of the molecule, and so altering the velocity of propagation. Thus if v and v' are the velocities of propagation along the axis of rays polarised circularly in the two directions, it comes out that approximately

$$\frac{v}{v'} = 1 + h \frac{\omega}{\gamma},$$

where h is a constant depending on the form of the gyrostats, ω is the angular velocity of the precessional rotation of the gyrostats, and γ is the velocity of rotation of the gyrostats. This is a totally different law to the action of the *crude* gyrostatic molecule, and is in accordance with experiment.

If now we have *improved* gyrostatic molecules imbedded in the ether, their minute rotations will affect the velocity of propagation in the manner of crude molecules, but their translations will affect the velocity in the manner now elucidated. But observe that by diminishing the size of the molecules the influence of the rotational motion diminishes, but the influence of the translational motion remains the same (on the assumption that the angular gyrostatic velocity is kept the same and the ratio of mass of gyrostats to mass of molecule remains the same). Hence, if we have small enough molecules, the law which agrees with experiment alone holds.

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range and pull it at the end of the other. You meet this principle quite often; it is well known in the construction of clock escapements. To hurry up the vibratory motion, we must add to the return force of particle No. 1 by the action of the spring connected to the handle *P*. From looking at the thing, and learning to understand it by making the experiment if you do not understand it by brains alone, you will see that everything that I am saying is obvious. It is not satisfactory, however, to speak of these things in general terms unless we can submit them to a rigorous analysis." A. S. H.

*The letter on p. 244, which was written by Sir Wm Thomson from New York just before sailing, refers to this as a misapprehension on his part, and that the (un[illegible] molecule gives the correct law.

This is a very satisfactory state of affairs, and I believe it is the first time that Sir William Thomson's hint about this phenomenon, so long ago thrown out, has been developed.

There is still so much matter in the lectures that I have not touched upon that I am in some difficulty as to what to omit. But I certainly should like to transcribe nearly the whole of the last lecture. This is of course impossible, but I will claim a little space for some remarks on Rankine's beautiful but futile attempt to get over the fatal difficulty of double refraction (p. 271):

"Suppose here a massless rigid lining of our ideal cavity in the luminiferous ether. Let there be a massive, heavy molecule inside, with fluid around it. The main thing is that this molecule, which only affects the effective inertia of the ether by adding its own mass to the moving mass of the ether, has æolotropy of inertia. Imagine this spherule (drawing on the board an oblate spheroid with axis vertical) moving first in a horizontal direction. The effective inertia of this sheath will be altered if it moves to and fro in a vertical direction, there being, by hypothesis, liquid between it and the ether. The density of this mass must be greater than the density of the liquid, that is all. If there is danger of its coming to the sides of the cavity, let there be springs to keep it in place, if you like, but let its connection with the lining of the cavity be in the main through fluid pressure. Then its effective inertia is different in different directions. This fluid lining seems to hit off the very thing we wanted. Now comes Rankine's want of strength. He cut around the edges of it, and, I think, rather jumped at it, and put down a wave-surface the same as Fresnel's, and said that it came to that. But, alas! Stokes (long before Lord Rayleigh suggested it) showed that it would give a different surface from Fresnel's. Lord Rayleigh, in repeating Rankine's suggestion, showed his strength where Rankine was not so strong in mathematical powers of grappling with a difficult mathematical problem. Lord Rayleigh is a man who grapples with a difficulty and sees how much he can do with it. He puts it aside if he cannot solve it, but he never shirks it. Rankine was not a mathematician in that sense at all. Lord Rayleigh finds, not Fresnel's wave-surface, but a wave-surface differing from Fresnel's by certain terms appearing in reciprocals instead of directly."

Now Stokes has shown that Huyghen's construction satisfies experiment with great accuracy, and hence Rankine's effort fails. The desperate condition of the wave-theory is shown by the words penned by Lord Rayleigh before he knew of Stokes's experiments (p. 272): "Should the verdict go against the view of the present paper, it is hard to see how any consistent theory is possible which shall embrace at once the laws of scattering, regular reflection and double refraction."

It appears, then, that after all the labor which has been expended upon the wave-theory of light, it fails absolutely, and, as it seems, hopelessly, in two points of primary importance. One is the extinction of the ray polarised by reflection; the other is double refraction. In other matters we have difficulties, but we can see a possible means of escape. Here there seems to be none.

Before concluding this series of articles I wish to say a little more about the manner of their delivery. It is a rare experience for students to have the opportunity of studying the workings of a great mind while grappling with a problem. This is what occurred during the three weeks of the Baltimore lectures. During the whole of this period one or two ardent students were hunting up references in the Peabody Library, &c., and literally filled Sir William Thomson's rooms with the results of their searches, and Sir William generally read these books. He says (p. 76): "An interminable number of books have been brought to me, and in every one of them I have found something very important." But at p. 98 he says: "I got another quarter-hundredweight of books on the subject. I have not yet read them all through." In this way he often came for the first time upon researches bearing on the question in hand. Thus (p. 77): "I only found this morning that Lommel also goes on to double refraction of light in crystals [with imbedded molecules]. The very problem I am breaking my head against." Evidence is always cropping up that the author is in the habit of going farther into a subject by original mathematical analysis than by reading up other people's work. I will give some examples. Speaking of a reference by Rankine to cubic asymmetry, he says: "I only came across this [illegible] two or three days ago. But I remember going through the same [illegible] not long ago, and I [illegible] to Stokes—I always consulted my [illegible], Stokes, whenev[illegible] a chance—'Surely there may be such a thing found to exemplify this kind of asymmetry; would it not be likely to be found in crystals of the cubic class?' Stokes—he knew almost everything—instantly said: 'Oh, Sir David Brewster thought he had found it in cubic crystals, but there was an explanation that it seemed to be owing to the effect of the cleavage planes or the separation of the crystal into several crystalline laminæ'" (p. 158). Then again he says:—"I am ashamed to say that I never heard of anomalous dispersion until after I found it lurking in the formulas. I said to myself, 'These formulas would imply that, and I never heard of it;' and when I looked into the matter I found, to my shame, that a thing which had been known by others for eight or ten years I had not known until I found it in the dynamics" (p. 120). Once more we find:—"I was thinking about this, three days ago, and said to myself, 'There must be bright lines of reflection from bodies in which we have those molecules that can produce intense absorption. Speaking about it to Lord Rayleigh at breakfast, he informed me of this paper of Stokes's, and I looked and saw that what I had thought of was there. It was known perfectly well, but the molecule first discovered it to me. I am exceedingly interested about these things, since I am only beginning to find out what everybody else knew, such as anomalous dispersion, and those quasi colors, and so on" (p. 282).

The purely physical bent of the author's reasoning is well shown in speaking of Rankine's work at p. 270: "I do not think I would like to suggest that Rankine's molecular hypothesis is of very great importance. The title is of more importance than anything else in the work. Rankine was that kind of genius that his names were of enormous suggestiveness, but we cannot say that always of the substance. We cannot find a foundation for a great deal of his mathematical writings, and there is no explanation of his kind of matter. I never satisfy myself until I can make a mechanical model of a thing. If I can make a mechanical model, I can understand it. As long as I cannot make a mechanical model all the way through, I cannot understand; and that is why I cannot get* the electro-magnetic theory. I firmly believe in an electro-magnetic theory of light, and that, when we understand electricity and magnetism and light, we shall see them all together as parts of a whole. But I want to understand light as well as I can without introducing things that we understand even less of. That is why I take plain dynamics. I can get a model in plain dynamics, I cannot in electro-magnetics. But so soon as we have rotators to take the parts of magnets and something imponderable to take the part of magnetism, and realize by experiment Maxwell's beautiful ideas of electric displacements, and so on, then we shall see electricity, magnetism, and light closely united and grounded in the same system."

The model of an electro-magnetic ether described by Prof. Fitzgerald on March 28, to the Physical Society, founded on Clerk Maxwell's celebrated papers in the *Philosophical Magazine* in 1860 and 1861, goes a long way to clear away the objection raised by Sir William Thomson.

In reading these lectures, it must be remembered that they are uncorrected *verbatim* reports, and one is surprised at seeing that the matter is so continuous and readable. A considerable freshness is given by the conversational interludes and remarks, which would not perhaps have appeared in a written work. As mentioned before, Sir William spoke of the pressural wave as an animal; this was very happy, as he had just before called it the *bête noir* of the mathematicians. He says at p. 34:—"I do not like the words 'paradoxical phenomenon.' 'Curious phenomenon' or 'interesting phenomenon' would be better. There is no paradox in science. We may call it a *dynamor*, but not a *parador*." At p. 115 he says:—"The struggle of 1815 (that is not the same idea as *la grande guerre de* 1815) was, who was to rule the waves, Cauchy or Poisson?"

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The purely physical bent of the author's reasoning is well shown in speaking of Rankine's work at p. 270: "I do not think I would like to suggest that Rankine's molecular hypothesis is of very great importance. The title is of more importance than anything else in the work. Rankine was that kind of genius that his names were of enormous suggestiveness, but we cannot say that always of the substance. We cannot find a foundation for a great deal of his mathematical writings, and there is no explanation of his kind of matter. I never satisfy myself until I can make a mechanical model of a thing. If I can make a mechanical model, I can understand it. As long as I cannot make a mechanical model all the way through, I cannot understand; and that is why I cannot get[*] the electro-magnetic theory. I firmly believe in an electro-magnetic theory of light, and that, when we understand electricity and magnetism and light, we shall see them all together as parts of a whole. But I want to understand light as well as I can without introducing things that we understand even less of. That is why I take plain dynamics. I can get a model in plain dynamics, I cannot in electro-magnetics. But so soon as we have rotators to take the parts of magnets and something imponderable to take the part of magnetism, and realize by experiment Maxwell's beautiful ideas of electric displacements, and so on, then we shall see electricity, magnetism, and light closely united and grounded in the same system."

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"This is the expression for the square of the refractive index, as it is affected by the presence of molecules arranged in that way. It is too late to go into this for interpretation just now, but I will tell you that if you take τ considerably less than κ_1 and very much greater than κ_2 you will get a formula with enough disposable constants to represent the index of refraction by an empirical formula, as it were, which from what we know, and from what Sellmeier and Ketteler have shown, we can accept as ample for representing the refraction index of most transparent substances. We have the means of extending its powers and introducing the effects of those other terms, so that we have a formula which is more than sufficient to give us a mathematical expression of the refrangibility in the case of any transparent body whose refrangibility is reliable."

In fact the above formula is equivalent to the well-known formula of Cauchy and others, viz.:

$$\mu = \mu_0 (A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4} + \ldots)$$

when we are not dealing with critical cases. Examining the formula for $\frac{\tau^2}{\lambda^2}$ or μ^2, we see that as τ approaches κ_1, μ^2 becomes infinite, and for τ a little greater than κ_1, μ^2 is negative, which is impossible, and we can have no assignable velocity for such a period—*i. e.* there is absorption for all values of $\tau > \kappa_1$, which make μ^2 negative. Moreover, owing to the existence of a critical period, κ_1, the refractive index is abnormally increased for values of τ which are just less than κ_1, and it is abnormally diminished just when μ^2 becomes positive. This means that the refrangibility of rays in a highly absorbent medium, in the neighborhood of the band of absorption, is anomalous in the direction indicated by Kundt in his researches on anomalous dispersion. Here is what we find at p. 150 on critical values of τ and the manner of absorption:—

"We shall try to see something more of the effect of light propagated through a medium of a period exactly equal κ_1. I believe each sequence of vibrations will throw in a little energy which will spread out among the different possible motions of the molecule. The combination of the sequences, forming what we call continuous light, is not a continuous phenomenon at all. I believe that the first effect when light begins will be: each sequence of waves of the exact period throws in some energy into the molecule. That goes on until, somewhere or other, the molecule gets uneasy. It takes in an enormous amount of energy before it begins to get particularly uneasy. It then moves about, and begins to collide with its neighbors, perhaps, and will therefore give you heat in the gas, if it be a gaseous molecule. It goes on colliding with the other molecules, and in that way imparting its energy to them. The energy will be simply carried away, by convection if you please, or a part of it perhaps. Each molecule set to vibrating in that way becomes a source of light, and so we may explain the radiation of heat from the molecule after it has been got into the molecule by sequences of waves of light. I believe we can so explain the augmented pressure of a gas due to the absorption of heat in it.

"We may consider, however, that the chiefest vibration of the molecule is that in which the nucleus goes in one direction, and the shell in the opposite direction, but with a great amount of energy in the interior vibrations and very little in the shell, so that the shell may go on giving out phosphorescent energy for two or three hours or days, simply vibrating for ever, except in so far as the energy is drawn off and allowed to give motion to other bodies."

A great deal more is said about the influence of critical periods upon anomalous dispersion, but, as the author says, "it is like fiddling when Rome is burning to discuss anomalous dispersion when double refraction is waiting to be explained," so I will pass from this subject.

We have in the lectures some indications of the effect of introducing a gyrostat inside the shell molecule, especially with relation to magnetic rotation of the plane of polarisation. On this subject the author said sadly: "But alas! my results give me another law, not more effect with greater frequency, but less effect with greater frequency, and according to the inverse of the wave-length.[*] I therefore lay it aside for the present, but with perfect faith that the principle of explanation of the thing is there," (p. 244).

But, on returning to this country, a more complete theory of the gyrostatic molecule was worked out, sent to America, and incorporated in the lectures. In my next and concluding notice I shall touch on the further developments if space permits.

III.

Before proceeding with new parts of this subject, I wish to say a few words about "fiddling while Rome is burning." Sir William Thomson writes to me that the expression was used while discussing some mathematical triviality, and he wishes to be relieved of the imputation of speaking disrespectfully of *anomalous dispersion*, which he says is quite as important as *double refraction*. I grant this, but my interpretation of his language when I heard the lecture was that so many possible ways had been shown of explaining anomalous dispersion that it was mere child's play (or fiddle-playing) to discuss it while the burning question of double refraction awaited explanation, upon which question seems to depend the whole safety of the wave-theory of light, that theory being in imminent danger of destruction therefrom.

I shall now give a brief account of the gyrostatic molecules, crude and improved. The crude one is a fly-wheel inside a massless shell. Here there is no gyrostatic action opposing a motion of translation, but only opposing a motion of rotation. This is the molecule which was stated to give the wrong kind of variation of magneto-optic rotation with variation of wave-length. The improved gyrostatic molecule (p. 320) consists of two fly-wheels on one axis. But the axis is cut in two in the middle between them, and the parts fitted together by a ball and cylinder joint. The other ends of the half axes are supported in ball-and-socket joints in the massless shell. So far as rotation of the shell is concerned, this acts like one gyrostat, the axis always remaining in one line. But if the shell be frictionless, the ether can only give translational movement to it, and the double gyrostat produces a gyrostatic effect when the molecule is accelerated in any direction except along the axis.

The special function of this molecule is to explain magneto-optic rotation of the plane of polarisation. The axis of the molecule is supposed to be the direction of the lines of force. It is required to be proved that, gyrostatic molecules being imbedded in the ether with their axes parallel and their directions of rotation the same, the velocity of propagation of a circular disturbance going with the gyrostat is greater than that of a circular disturbance in the opposite direction. With a steady propagation of circularly polarised light, the gyrostats will clearly execute a precessional motion. The theory of this motion is examined after the manner of Thomson and Tait's "Natural Philosophy" for a ray along the axes, and the gyrostatic effect is found to be equivalent to altering the effective density of the molecule, and so altering the velocity of propagation. Thus if v and v' are the velocities of propagation along the axis of rays polarised circularly in the two directions, it comes out that approximately

$$\frac{v}{v'} = 1 + h\frac{\omega}{\gamma},$$

where h is a constant depending on the form of the gyrostats, ω is the angular velocity of the precessional rotation of the gyrostats. and γ is the velocity of rotation of the gyrostats. This is a totally different law to the action of the *crude* gyrostatic molecule, and is in accordance with experiment.

If now we have *improved* gyrostatic molecules imbedded in the ether, their minute rotations will affect the velocity of propagation in the manner of crude molecules, but their translations will affect the velocity in the manner now elucidated. But observe that by diminishing the size of the molecules the influence of the rotational motion diminishes, but the influence of the translational motion remains the same (on the assumption that the angular gyrostatic velocity is kept the same and the ratio of mass of gyrostats to mass of molecule remains the same). Hence, if we have small enough molecules, the law which agrees with experiment alone holds.

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range and pull it at the end of the other. You meet this principle quite often; it is well known in the construction of clock escapements. To hurry up the vibratory motion, we must add to the return force of particle No. 1 by the action of the spring connected to the handle *P*. From looking at the thing, and learning to understand it by making the experiment if you do not understand it by brains alone, you will see that everything that I am saying is obvious. It is not satisfactory, however, to speak of these things in general terms unless we can submit them to a rigorous analysis." A. S. H.

[*] The letter on p. 244, which was written by Sir Wm. Thomson from New York just before sailing, refers to this as a misapprehension on his part, and that the (unimproved) molecule gives the correct law. A. S. H.

This is a very satisfactory state of affairs, and I believe it is the first time that Sir William Thomson's hint about this phenomenon, so long ago thrown out, has been developed.

There is still so much matter in the lectures that I have not touched upon that I am in some difficulty as to what to omit. But I certainly should like to transcribe nearly the whole of the last lecture. This is of course impossible, but I will claim a little space for some remarks on Rankine's beautiful but futile attempt to get over the fatal difficulty of double refraction (p. 271):

"Suppose here a massless rigid lining of our ideal cavity in the luminiferous ether. Let there be a massive, heavy molecule inside, with fluid around it. The main thing is that this molecule, which only affects the effective inertia of the ether by adding its own mass to the moving mass of the ether, has æolotropy of inertia. Imagine this spherule (drawing on the board an oblate spheroid with axis vertical) moving first in a horizontal direction. The effective inertia of this sheath will be altered if it moves to and fro in a vertical direction, there being, by hypothesis, liquid between it and the ether. The density of this mass must be greater than the density of the liquid, that is all. If there is danger of its coming to the sides of the cavity, let there be springs to keep it in place, if you like, but let its connection with the lining of the cavity be in the main through fluid pressure. Then its effective inertia is different in different directions. This fluid lining seems to hit off the very thing we wanted. Now comes Rankine's want of strength. He cut around the edges of it, and, I think, rather jumped at it, and put down a wave-surface the same as Fresnel's, and said that it came to that. But, alas! Stokes (long before Lord Rayleigh suggested it) showed that it would give a different surface from Fresnel's. Lord Rayleigh, in repeating Rankine's suggestion, showed his strength where Rankine was not so strong in mathematical powers of grappling with a difficult mathematical problem. Lord Rayleigh is a man who grapples with a difficulty and sees how much he can do with it. He puts it aside if he cannot solve it, but he never shirks it. Rankine was not a mathematician in that sense at all. Lord Rayleigh finds, not Fresnel's wave-surface, but a wave-surface differing from Fresnel's by certain terms appearing in reciprocals instead of directly."

Now Stokes has shown that Huyghen's construction satisfies experiment with great accuracy, and hence Rankine's effort fails. The desperate condition of the wave-theory is shown by the words penned by Lord Rayleigh before he knew of Stokes's experiments (p. 272): "Should the verdict go against the view of the present paper, it is hard to see how any consistent theory is possible which shall embrace at once the laws of scattering, regular reflection and double refraction."

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Moreover, if n be the rigidity modulus, k the bulk modulus, δ the cubic dilatation, and $m = k + \frac{1}{3} n$, we have

$$P = (m - n)\,\delta,$$

$$T = n\left(\frac{d\xi}{dz} + \frac{d\zeta}{dx}\right),$$

with similar expressions for Q, R, S, U.

Thence he shows that the equations

$$\rho\frac{d^2\xi}{dt^2} = m\frac{d\delta}{dx} + n\nabla^2\xi, \text{ etc.},$$

(with the condition $\frac{d\xi}{dx} + \frac{d\eta}{dy} + \frac{d\zeta}{dz} = O$ in an incompressible substance), contain every possible solution, and he proceeds to discuss special cases of the general solution which may be true of waves propagated by molecules through the ether. Here his desire for physical conceptions appears, and his hatred of mathematical *aphasia*. He considers the case of a ball moving to and fro, of a ball twisting about an axis, of a globe becoming alternately prolate and oblate, of a rod twisted in opposite directions at the two ends, and of the Thomson-Helmholtz molecule, which is a heavy mass connected by massless springs with a massless inclosing shell, or there may be several shells inclosing each other, connected by springs with a dense mass in the centre (far more dense than the ether).

Here he discusses the manner in which a molecule may be supposed to give off its vibrations to the ether. Does it gradually increase in intensity and gradually die out, or how does it act? Here is what he says on this much-neglected point at p. 94:

"The kind of thing that the luminous vibrator consists in seems to me to be a sudden initiation of a set of vibrations and a sequence of vibrations from that initiation which will naturally become of smaller and smaller amplitude. . . . Why a sudden start? Because I believe that the light of the natural flame or of the arc light or of any other known source of light must be the result of sudden shocks from a number of vibrators. Take the light obtained by striking two quartz pebbles together. You have all seen that. There is one of the very simplest sources of light. . . . What sort of a thing can the light be that proceeds from striking two quartz pebbles together? Under what circumstances can we conceive a group of waves of light to begin gradually and to end gradually? You know what takes place in the excitation of a fiddle-string or a tuning-fork by a bow. The vibrations gradually get up from zero to a maximum, and then, when you take the bow off, gradually subside. I cannot see anything like that in the source of light. On the contrary, it seems to me to be all shocks—a sudden beginning and gradual subsidence."

The light coming from a single shock is, of course, polarised always in the same direction. Sellmeier's deductions from Fizeau's experiment shows that there is no serious fading in 50,000 vibrations. Helmholtz introduces viscous terms which absorb the energy and might prevent the possibility of 50,000 vibrations from one shock. That is a retrograde step. Absorption can be explained without viscous terms.

Such speculations, when coming from one of less grasp of physical facts, would attract but little attention. But here all kinds of useful suggestions are continually thrown out for experiment and for hypotheses. He is striving to get at the physical meaning of radiation, absorption, anomalous dispersion, fluorescence, and phosphorescence, and here is what he says on some of these points at p. 90:—

"But there are cases in which we have that tremendous jangling, and that is in the fluorescence of such a thing as uranium glass, which lasts for several seconds after the exciting light is taken away, and then again in phosphorescence that lasts for hours and days. There have been exceedingly interesting beginnings in the way of experiments already made, but I think no one has found whether initial refraction is exactly the same as permanent refraction. For this purpose we might use Becquerel's phosphoroscope, or we might take such an appliance as Prof. Michaelson has been using for light, and get something enormously more searching than Becquerel's phosphoroscope, and try whether, in the first hundredth of a second, there is any indication of a different wave-velocity from that which you would have when white light passes continuously in the usual manner of refraction. If in the methods employed for ascertaining the velocity of light in a transparent body . . . we apply a test for an instantaneous refraction, I have no doubt we shall get negative results, but yet properties of ultimate importance. We might take bodies in which, like uranium glass, the phosphorescence lasts only a few thousandths of a second; and then, again, bodies in which phosphorescence lasts for minutes and hours. With some of these we should have anomalous dispersion, gradually fading away after a time. I should think that, by experimenting, and so on, we should find some very interesting results of this kind."

In his mathematics he suppresses the condensational wave, and, in doing so, makes reference to the electro-magnetic theory of light, which, he thinks, has added nothing to our physical conceptions of the ether. In treating, further on, of reflection and refraction, he speaks a great deal of the pressural wave, which many authors have called a condensational wave. I find that in some points my notes are fuller than the reporter's. I cannot find there the following characteristic passage about the pressural wave:—"People have tried to muddle this. The pressural wave has been the difficulty. Cauchy starved the animal, M'Cullagh and Neumann didn't know of its existence, Haughton put it in an Irish car and it wouldn't go, Green and Rayleigh treated it according to its merits."[*]

With regard to the possibility of a condensational wave, and to the electro-magnetic theory of light, we find, on pp. 40–41:—

"We ignore this condensational wave in the theory of light. We are sure that its energy, at all events, if it is not null, is very small in comparison with the luminiferous vibrations we are dealing with. But to say that it is absolutely null would be an assumption we have no right to make. When we look through the little universe that we know, and think of the transmission of electrical force and of the transmission of magnetic force, and of the transmission of light, we have no right to assume that there is not something else that our philosophy does not dream of. We have no right to assume that there may not be condensational vibration in the luminiferous ether. We only do know that any vibrations of this kind which are excited by the reflection and refraction of light are certainly of very small energy compared with the energy of the light from which they proceed. The fact of the case as regards reflection and refraction is this: that, unless the luminiferous ether is absolutely incompressible, the reflection and refraction of light must generally give rise to waves of condensation. Waves of distortion may exist without waves of condensation, but waves of distortion cannot be reflected at the boundary surface between two mediums without exciting in each medium a wave of condensation. When we come to the subject of reflection and refraction we shall see how to deal with these condensational waves, and find how easy it is to get quit of them by supposing the medium incompressible. But it is always to be kept in mind to be examined into: Are there or are there not very small amounts of condensational waves generated in reflection and refraction; and may, after all, the electric force not depend on the waves of condensation? Suppose that we have at any place in air, or in luminiferous ether, a body that, through some action we need not describe, but which is conceivable, is alternately positively and negatively electrified: may it not be that this will be the cause of condensational waves?" It is then supposed that two spherical conductors are connected to the terminals of an alternating dynamo machine, and the quotation proceeds:—

"It is perfectly certain, if we turn the machine slowly, that in the neighborhood of the conductors we will have alternately positively and negatively electrified elements with reversals perhaps two or three hundred per second of time, with a gradual transition from negative through zero to positive, and the same thing all through space; and we can tell exactly what is the potential at each point. Now, does any one believe that, if that revolution was made fast enough, the electrostatic law would follow? Every one believes that, if that process be conducted fast enough several million times, or millions of million times per second, we should be far from fulfilling the electrostatic law in the electrification of the air in the neighborhood. It is absolutely certain that such an action as that going on would give rise to electrical waves. Now it does seem probable to me that electrical waves are condensational waves in luminiferous ether, and probably it would be that the propagation of these waves would be enormously faster than the propagation of ordinary light waves. I am quite conscious, when speaking of this, of what has been done in the so called electro-magnetic theory of light. I know the propagation of electric impulse along an insulated wire surrounded by gutta-percha, which I worked out myself about the year 1854, and in which I found a velocity comparable with the velocity of light. . . . That is a very different case from this, and I have waited in vain to see how we can get any justification of the way of putting it in the so-called electro-magnetic theory of light."

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[*] The passage may be found on p. 233. There are some omissions from the lectures, but only for reasons indicated by Sir Wm. Thomson either at the time in the class-room, or subsequently by letters, which have been incorporated in the report. A. S. H.

In those parts of the lectures which deal with wave propagation in an isotropic medium, by far the most interesting parts are those which treat of the conditions at bounding surfaces, whether these surfaces be reflecting and refracting surfaces or surfaces of radiating molecules, or surfaces of absorbing molecules. Lord Rayleigh's investigations and his own on the likelihood of the density or the rigidity of the substance composing a molecule differing from that of the ether are also full of interest.

Much of this part of the subject has been thoroughly worked out before, but here the treatment is so original, the language is so suggestive, and I need hardly say that the whole course of lectures is so pregnant with useful ideas, that every one who reads this part will be well repaid.

Having now roughly indicated the novel points and the general mode of treatment of the problem in *molar* dynamics, I propose in the next notice to give some account of the problem in *molecular* dynamics, which occupied half of the time.

II.

In the present article Sir William Thomson's spring and shell molecule will be described and its theory sketched, in so far as this has been investigated with the view of getting over some of the difficulties which surround the wave theory of light. In Helmholtz's memoir on anomalous dispersion, a sketch of such a theory was published. But this new molecule differs from that of Helmholtz in several points, chiefly in the fact that absorption is not accounted for by any viscous action in the molecule dissipating the energy of vibration into low grade heat. Most readers who have ever visited the natural philosophy lecture-room in Glasgow University will recognize a very old friend in this new molecule, where they have seen it vibrating, I suppose, any time since the University occupied its present site. In appearance the molecule has been changed, but its theory as taught to the students there is identical. For a description of this molecule let us refer to page 10 of the lectures:—

"Imagine for a moment that we make a rude mechanical model. Let this be an infinitely rigid spherical shell; let there be another absolutely rigid shell inside of that, and so on, as many as you please. Naturally we might think of something more continuous than that, but I only wish to call attention to a crude mechanical explanation possibly of the effects of dispersion. Suppose we had luminiferous ether outside, and that this hollow space is of very small diameter in comparison with the wave length. Let zig-zag springs connect the outer rigid boundary with boundary number two. I use a zig-zag, not a spiral, spring which has the helical properties which we are not ready for yet, such properties as sugar and quartz have in disturbing the luminiferous vibrations. Suppose we have shells two and three also connected by a sufficient number of zig-zag springs, and so on; and let there be a solid nucleus in the centre with spring connections between it and the shell outside of it. If there is only one of these interior shells, you will have one definite period of vibration. Suppose you take away everything except that one interior shell; displace that shell and let it vibrate. The period of its vibration is perfectly definite. If you have an immense number of such shells with movable molecules inside of them, distributed through some portion of the luminiferous ether, you will put it into a condition in which the velocity of propagation of the wave will be different from what it is in the homogeneous luminiferous ether. You have what is called for, viz. a definite period; and the relation between the period of vibration in the light considered and the period of the free vibration of the shell will be fundamental in respect to the attempt of a mechanism of that kind to represent the phenomena of dispersion.

"If you take away everything except the one shell, you will have almost exactly, I think, the view of Helmholtz's paper—a crude model as it were of what Helmholtz makes his paper on anomalous dispersion. Helmholtz, besides that, supposes a certain degree or coefficient of viscous resistance against the vibration of the inner shell, relatively to the outer one. Helmholtz does not reduce it to a gross mechanical form like this, but merely assumes particles connected with the luminiferous ether and assumes a viscous motion to operate against the motion of the particles."

In the lectures the action of such a molecule when subjected to forced vibrations was illustrated by a model of ingenious construction, which among the irreverent passed by the name of the "wiggler." A steel wire was hung vertically, and five or six lathes 2 feet long and 2 inches wide were attached in a horizontal position to the wire, each one having three pins fixed in it for this purpose. These lathes were loaded at their ends, the weight on each lathe being less than that on the one above it. The lowest lathe was attached to a pendulum arrangement which impressed forced vibrations upon the system, the period being adjustable. The theory of such a system is the same as that of the molecule described above.

But in working out the theory a third type of vibrator was used, the identical one which vibrates in the lecture room at Glasgow. This is a series of weights attached to each other by vertical springs which can be stretched. The highest is the heaviest, and the others are arranged in the order of weight.

Calling P the lathe with forced vibrations (corresponding to the external massless shell acted on by the ether) and ξ its displacement, m_1, m_2, &c., are the successive masses, x_1, x_2, &c., are their displacements

$$u_2 = -\frac{c_2 x_1}{x_2},$$

and measures the relative displacement of m_1 and m_2. c_1, c_2, &c., are the constants of successive spring connections. $c_2(x_1 - x_2)$ is the force of restitution in virtue of the spring connection between x_1 and x_2. τ is the period of forced vibration.

We thus arrive at the equation

$$\frac{du_i}{d\tau} = -\frac{2}{\tau^3} \cdot \frac{1}{x_i^2}(m_i x_i^2 + m_{i+1} x^2_{i+1} + \ldots + m_j x_j^2),$$

and since the right hand member is essentially negative, it follows that all the u's diminish with increase of period. The critical cases occur when the period of forced vibration agrees with the natural period of any of the shells or lathes. When the forced vibration is very rapid, all successive masses move in opposite directions. When the forced period is slower, u_1 becomes zero, and x_1 is infinite—*i.e.*, the vibration of the lowest mass is infinite in comparison with the forced vibrator, and so with the other vibrators. When the forced period is slower, u_1 becomes negative, *i.e.*, the lowest mass begins to vibrate in the same direction as the forced vibrator. Successive critical cases occur as the forced period reaches the natural periods of successive vibrators. At the critical period for any one vibrator, all those below it are vibrating in one direction, while the critical one and those above it are executing very large vibrations in opposite directions successively.

These critical periods are admirably adapted for explaining absorption and also anomalous dispersion. In highly absorbing media which cut off a band of light from the spectrum, the refractive index for colors neighboring to the band is remarkable; thus light of greater wave-length than the band is refracted more, and light of less wave-length than the band is refracted less than in normal substances. Lord Rayleigh considered this to be due to the mutual influence of the vibrating molecule and ether. If the point of support of a pendulum is vibrated in a different period, the period of the pendulum is changed. Lommel seems to have been the first to make dispersion depend upon associated matter.

The influence of a large number of the spring and shell molecules distributed through the ether upon the velocity of light in that medium is examined and shown to depend upon the wave-length or period. Finally at p. 108 we obtain the following formula:

$$\frac{\tau^2}{\lambda^2} = \frac{1}{l}\left[\rho - c_1\tau^2\left\{1 + \frac{c_1\tau^{-2}}{m_1}\left(\frac{\kappa_1^2 R_1}{\kappa_1^2 - \tau^2} + \frac{\kappa_2^2 R_2}{\kappa_2^2 - \tau^2} + \ldots\right)\right\}\right]$$

ρ and l measure the density and rigidity.

$$R_i = \frac{\text{Energy of 1st shell } m_1}{\text{Energy of the whole.}} \text{ for } \tau = \kappa_i$$

κi = the ith critical period.*

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* The critical periods denoted by κ_i are the roots of $\frac{\xi}{x_1} = 0$ or $u_1 = 0$. Vibrations of the molecule in these periods can evidently communicate no motion to the surrounding ether, for $\xi = 0$ for finite values of x_1. On the contrary, if ξ has an actual value in one of these periods x must be infinite. In other words, the energy of motions of the ether in these periods is infinitely rapidly absorbed into the molecule. An example mentioned by Sir Wm. Thomson is to vibrate a watch in the period of its hair spring; the balance wheel will soon vibrate enormously and break. Sir Wm. Thomson said on this point before he introduced the mathematical analysis of the subject (p. 37): "If you want to hurry up a particle (or a swing, for example) you shove it at the end of one

"This is the expression for the square of the refractive index, as it is affected by the presence of molecules arranged in that way. It is too late to go into this for interpretation just now, but I will tell you that if you take τ considerably less than κ_1 and very much greater than κ_2 you will get a formula with enough disposable constants to represent the index of refraction by an empirical formula, as it were, which from what we know, and from what Sellmeier and Ketteler have shown, we can accept as ample for representing the refraction index of most transparent substances. We have the means of extending its powers and introducing the effects of those other terms, so that we have a formula which is more than sufficient to give us a mathematical expression of the refrangibility in the case of any transparent body whose refrangibility is reliable."

In fact the above formula is equivalent to the well-known formula of Cauchy and others, viz.:

$$\mu = \mu_0 (A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4} + \ldots)$$

when we are not dealing with critical cases. Examining the formula for $\frac{\tau^2}{\lambda^2}$ or μ^2, we see that as τ approaches κ_1, μ^2 becomes infinite, and for τ a little greater than κ_1, μ^2 is negative, which is impossible, and we can have no assignable velocity for such a period—*i.e.* there is absorption for all values of $\tau > \kappa_1$, which make μ^2 negative. Moreover, owing to the existence of a critical period, κ_1, the refractive index is abnormally increased for values of τ which are just less than κ_1, and it is abnormally diminished just when μ^2 becomes positive. This means that the refrangibility of rays in a highly absorbent medium, in the neighborhood of the band of absorption, is anomalous in the direction indicated by Kundt in his researches on anomalous dispersion. Here is what we find at p. 150 on critical values of τ and the manner of absorption:—

"We shall try to see something more of the effect of light propagated through a medium of a period exactly equal κ_1. I believe each sequence of vibrations will throw in a little energy which will spread out among the different possible motions of the molecule. The combination of the sequences, forming what we call continuous light, is not a continuous phenomenon at all. I believe that the first effect when light begins will be: each sequence of waves of the exact period throws in some energy into the molecule. That goes on until, somewhere or other, the molecule gets uneasy. It takes in an enormous amount of energy before it begins to get particularly uneasy. It then moves about, and begins to collide with its neighbors, perhaps, and will therefore give you heat in the gas, if it be a gaseous molecule. It goes on colliding with the other molecules, and in that way imparting its energy to them. The energy will be simply carried away, by convection if you please, or a part of it perhaps. Each molecule set to vibrating in that way becomes a source of light, and so we may explain the radiation of heat from the molecule after it has been got into the molecule by sequences of waves of light. I believe we can so explain the augmented pressure of a gas due to the absorption of heat in it.

"We may consider, however, that the chiefest vibration of the molecule is that in which the nucleus goes in one direction, and the shell in the opposite direction, but with a great amount of energy in the interior vibrations and very little in the shell, so that the shell may go on giving out phosphorescent energy for two or three hours or days, simply vibrating for ever, except in so far as the energy is drawn off and allowed to give motion to other bodies."

A great deal more is said about the influence of critical periods upon anomalous dispersion, but, as the author says, "it is like fiddling when Rome is burning to discuss anomalous dispersion when double refraction is waiting to be explained," so I will pass from this subject.

We have in the lectures some indications of the effect of introducing a gyrostat inside the shell molecule, especially with relation to magnetic rotation of the plane of polarisation. On this subject the author said sadly: "But alas! my results give me another law, not more effect with greater frequency, but less effect with greater frequency, and according to the inverse of the wave-length.* I therefore lay it aside for the present, but with perfect faith that the principle of explanation of the thing is there," (p. 244).

But, on returning to this country, a more complete theory of the gyrostatic molecule was worked out, sent to America, and incorporated in the lectures. In my next and concluding notice I shall touch on the further developments if space permits.

III.

Before proceeding with new parts of this subject, I wish to say a few words about "fiddling while Rome is burning." Sir William Thomson writes to me that the expression was used while discussing some mathematical triviality, and he wishes to be relieved of the imputation of speaking disrespectfully of *anomalous dispersion*, which he says is quite as important as *double refraction*. I grant this, but my interpretation of his language when I heard the lecture was that so many possible ways had been shown of explaining anomalous dispersion that it was mere child's play (or fiddle-playing) to discuss it while the burning question of double refraction awaited explanation, upon which question seems to depend the whole safety of the wave-theory of light, that theory being in imminent danger of destruction therefrom.

I shall now give a brief account of the gyrostatic molecules, crude and improved. The crude one is a fly-wheel inside a massless shell. Here there is no gyrostatic action opposing a motion of translation, but only opposing a motion of rotation. This is the molecule which was stated to give the wrong kind of variation of magneto-optic rotation with variation of wave-length. The improved gyrostatic molecule (p. 320) consists of two fly-wheels on one axis. But the axis is cut in two in the middle between them, and the parts fitted together by a ball and cylinder joint. The other ends of the half axes are supported in ball-and-socket joints in the massless shell. So far as rotation of the shell is concerned, this acts like one gyrostat, the axis always remaining in one line. But if the shell be frictionless, the ether can only give translational movement to it, and the double gyrostat produces a gyrostatic effect when the molecule is accelerated in any direction except along the axis.

The special function of this molecule is to explain magneto-optic rotation of the plane of polarisation. The axis of the molecule is supposed to be the direction of the lines of force. It is required to be proved that, gyrostatic molecules being imbedded in the ether with their axes parallel and their directions of rotation the same, the velocity of propagation of a circular disturbance going with the gyrostat is greater than that of a circular disturbance in the opposite direction. With a steady propagation of circularly polarised light, the gyrostats will clearly execute a precessional motion. The theory of this motion is examined after the manner of Thomson and Tait's "Natural Philosophy" for a ray along the axes, and the gyrostatic effect is found to be equivalent to altering the effective density of the molecule, and so altering the velocity of propagation. Thus if v and v' are the velocities of propagation along the axis of rays polarised circularly in the two directions, it comes out that approximately

$$\frac{v}{v'} = 1 + h\frac{\omega}{\gamma},$$

where h is a constant depending on the form of the gyrostats, ω is the angular velocity of the precessional rotation of the gyrostats, and γ is the velocity of rotation of the gyrostats. This is a totally different law to the action of the *crude* gyrostatic molecule, and is in accordance with experiment.

If now we have *improved* gyrostatic molecules imbedded in the ether, their minute rotations will affect the velocity of propagation in the manner of crude molecules, but their translations will affect the velocity in the manner now elucidated. But observe that by diminishing the size of the molecules the influence of the rotational motion diminishes, but the influence of the translational motion remains the same (on the assumption that the angular gyrostatic velocity is kept the same and the ratio of mass of gyrostats to mass of molecule remains the same). Hence, if we have small enough molecules, the law which agrees with experiment alone holds.

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range and pull it at the end of the other. You meet this principle quite often; it is well known in the construction of clock escapements. To hurry up the vibratory motion, we must add to the return force of particle No. 1 by the action of the spring connected to the handle *P*. From looking at the thing, and learning to understand it by making the experiment if you do not understand it by brains alone, you will see that everything that I am saying is obvious. It is not satisfactory, however, to speak of these things in general terms unless we can submit them to a rigorous analysis." A. S. H.

* The letter on p. 244, which was written by Sir Wm. Thomson from New York just before sailing, refers to this as a misapprehension on his part, and that the (unimproved) molecule gives the correct law. A. S. H.

This is a very satisfactory state of affairs, and I believe it is the first time that Sir William Thomson's hint about this phenomenon, so long ago thrown out, has been developed.

There is still so much matter in the lectures that I have not touched upon that I am in some difficulty as to what to omit. But I certainly should like to transcribe nearly the whole of the last lecture. This is of course impossible, but I will claim a little space for some remarks on Rankine's beautiful but futile attempt to get over the fatal difficulty of double refraction (p. 271):

"Suppose here a massless rigid lining of our ideal cavity in the luminiferous ether. Let there be a massive, heavy molecule inside, with fluid around it. The main thing is that this molecule, which only affects the effective inertia of the ether by adding its own mass to the moving mass of the ether, has æolotropy of inertia. Imagine this spherule (drawing on the board an oblate spheroid with axis vertical) moving first in a horizontal direction. The effective inertia of this sheath will be altered if it moves to and fro in a vertical direction, there being, by hypothesis, liquid between it and the ether. The density of this mass must be greater than the density of the liquid, that is all. If there is danger of its coming to the sides of the cavity, let there be springs to keep it in place, if you like, but let its connection with the lining of the cavity be in the main through fluid pressure. Then its effective inertia is different in different directions. This fluid lining seems to hit off the very thing we wanted. Now comes Rankine's want of strength. He cut around the edges of it, and, I think, rather jumped at it, and put down a wave-surface the same as Fresnel's, and said that it came to that. But, alas! Stokes (long before Lord Rayleigh suggested it) showed that it would give a different surface from Fresnel's. Lord Rayleigh, in repeating Rankine's suggestion, showed his strength where Rankine was not so strong in mathematical powers of grappling with a difficult mathematical problem. Lord Rayleigh is a man who grapples with a difficulty and sees how much he can do with it. He puts it aside if he cannot solve it, but he never shirks it. Rankine was not a mathematician in that sense at all. Lord Rayleigh finds, not Fresnel's wave-surface, but a wave-surface differing from Fresnel's by certain terms appearing in reciprocals instead of directly."

Now Stokes has shown that Huyghen's construction satisfies experiment with great accuracy, and hence Rankine's effort fails. The desperate condition of the wave-theory is shown by the words penned by Lord Rayleigh before he knew of Stokes's experiments (p. 272): "Should the verdict go against the view of the present paper, it is hard to see how any consistent theory is possible which shall embrace at once the laws of scattering, regular reflection and double refraction."

It appears, then, that after all the labor which has been expended upon the wave-theory of light, it fails absolutely, and, as it seems, hopelessly, in two points of primary importance. One is the extinction of the ray polarised by reflection; the other is double refraction. In other matters we have difficulties, but we can see a possible means of escape. Here there seems to be none.

Before concluding this series of articles I wish to say a little more about the manner of their delivery. It is a rare experience for students to have the opportunity of studying the workings of a great mind while grappling with a problem. This is what occurred during the three weeks of the Baltimore lectures. During the whole of this period one or two ardent students were hunting up references in the Peabody Library, &c., and literally filled Sir William Thomson's rooms with the results of their searches, and Sir William generally read these books. He says (p. 76): "An interminable number of books have been brought to me, and in every one of them I have found something very important." But at p. 98 he says: "I got another quarter-hundredweight of books on the subject. I have not yet read them all through." In this way he often came for the first time upon researches bearing on the question in hand. Thus (p. 77): "I only found this morning that Lommel also goes on to double refraction of light in crystals [with imbedded molecules]. The very problem I am breaking my head against." Evidence is always cropping up that the author is in the habit of going farther into a subject by original mathematical analysis than by reading up other people's work. I will give some examples. Speaking of a reference by Rankine to cubic asymmetry, he says: "I only came across this in Rankine two or three days ago. But I remember going through the same thing myself not long ago, and I said to Stokes—I always consulted my great authority, Stokes, whenever I got a chance—'Surely there may be such a thing found to exemplify this kind of asymmetry; would it not be likely to be found in crystals of the cubic class?' Stokes—he knew almost everything—instantly said: 'Oh, Sir David Brewster thought he had found it in cubic crystals, but there was an explanation that it seemed to be owing to the effect of the cleavage planes or the separation of the crystal into several crystalline laminæ'" (p. 158). Then again he says:—"I am ashamed to say that I never heard of anomalous dispersion until after I found it lurking in the formulas. I said to myself, 'These formulas would imply that, and I never heard of it;' and when I looked into the matter I found, to my shame, that a thing which had been known by others for eight or ten years I had not known until I found it in the dynamics" (p. 120). Once more we find:—"I was thinking about this, three days ago, and said to myself, 'There must be bright lines of reflection from bodies in which we have those molecules that can produce intense absorption. Speaking about it to Lord Rayleigh at breakfast, he informed me of this paper of Stokes's, and I looked and saw that what I had thought of was there. It was known perfectly well, but the molecule first discovered it to me. I am exceedingly interested about these things, since I am only beginning to find out what everybody else knew, such as anomalous dispersion, and those quasi colors, and so on" (p. 282).

The purely physical bent of the author's reasoning is well shown in speaking of Rankine's work at p. 270: "I do not think I would like to suggest that Rankine's molecular hypothesis is of very great importance. The title is of more importance than anything else in the work. Rankine was that kind of genius that his names were of enormous suggestiveness, but we cannot say that always of the substance. We cannot find a foundation for a great deal of his mathematical writings, and there is no explanation of his kind of matter. I never satisfy myself until I can make a mechanical model of a thing. If I can make a mechanical model, I can understand it. As long as I cannot make a mechanical model all the way through, I cannot understand; and that is why I cannot get* the electro-magnetic theory. I firmly believe in an electro-magnetic theory of light, and that, when we understand electricity and magnetism and light, we shall see them all together as parts of a whole. But I want to understand light as well as I can without introducing things that we understand even less of. That is why I take plain dynamics. I can get a model in plain dynamics, I cannot in electro-magnetics. But so soon as we have rotators to take the parts of magnets and something imponderable to take the part of magnetism, and realize by experiment Maxwell's beautiful ideas of electric displacements, and so on, then we shall see electricity, magnetism, and light closely united and grounded in the same system."

The model of an electro-magnetic ether described by Prof. Fitzgerald on March 28, to the Physical Society, founded on Clerk Maxwell's celebrated papers in the *Philosophical Magazine* in 1860 and 1861, goes a long way to clear away the objection raised by Sir William Thomson.

In reading these lectures, it must be remembered that they are uncorrected *verbatim* reports, and one is surprised at seeing that the matter is so continuous and readable. A considerable freshness is given by the conversational interludes and remarks, which would not perhaps have appeared in a written work. As mentioned before, Sir William spoke of the pressural wave as an animal; this was very happy, as he had just before called it the *bête noir* of the mathematicians. He says at p. 34:—"I do not like the words 'paradoxical phenomenon.' 'Curious phenomenon' or 'interesting phenomenon' would be better. There is no paradox in science. We may call it a *dynamox*, but not a *paradox*." At p. 115 he says:—"The struggle of 1815 (that is not the same idea as *la grande guerre de* 1815) was, who was to rule the waves, Cauchy or Poisson?"

To many it will seem, after reading these lectures containing a review of what has been done and suggestions of what might be done, that certain facts are hopelessly irreconcilable with the wave-theory of light. Sir William Thomson has certainly not shirked a single difficulty, and perhaps has even made them look more glaring than is necessary. But, if this be an error, it is on the right side.

The reporter has introduced into the volume some doggerel rhymes read by a certain student of the lectures at a farewell dinner at Baltimore given by President Gilman:—

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*These reports are generally quite *verbatim*, but I am sure Sir William Thomson is not responsible for this characteristic Americanism.—G. F.—(See on this note, letters in *Science*, of "A. G.", June 5, p. 454, and "E. W. C.", June 19, p. 494.—A. S. H.).

The Lament of the Twenty-one Coefficients at parting from each other and from their Esteemed Molecule.

An æolotropic molecule was looking at the view,
Surrounded by his coefficients twenty-one or two,
And wondering whether he could make a sky of azure blue,
With plagiotatic a b c and thlipsinomic Q.

They looked like sand upon the shore with waves upon the sea,
But the waves were all too wilful and determined to be free;
And in spite of n's rigidity they never could agree
In becoming quite subservient to thlipsinomic P.

Then web-like coefficients and a loaded molecule,
With a noble wiggler at their head, worked hard as Haughton's mule;
But the waves all laughed, and said, "A wiggler, thinking he could rule
A wave, was nothing better than a sidelong, normal fool."

So the coefficients sighed, and gave a last tangential skew,
And a shook hands with b and c, and S and T and U,
And with a tear they parted; but they said they would be true
To their much-belovèd wiggler and to thlipsinomic Q.

Signed, (g, f), *a Cross Coefficient now Annulled.*

The social and scientific intercourse of these three weeks at Baltimore was an experience that will be forgotten by none of the twenty-one coefficients, and they all sympathized with Sir William Thomson in his concluding remarks at p. 289:—

"I am exceedingly sorry that our twenty-one coefficients are to be scattered, but, though scattered far and wide, I hope we will still be coefficients working together for the great cause we are all so much interested in. I would be most happy to look forward to another conference, and the one damper to that happiness is that this one is now to end, and we shall be compelled to look forward for a time—I hope only for a time, and that we shall all meet again in some such way. I would say to those whose homes are on this side of the Atlantic, 'Come on the other side and I will welcome you heartily, and we may have more conferences.' Whether we have such a conference on this side or on the other side of the Atlantic again it will be a thing to look forward to—as this is to look back upon—as one of the most precious incidents I can possibly have. I suppose we must say farewell!"

ERRATA AND ADDITIONAL NOTES.

[From *Nature*, No. 801, London, March 5, 1885].

As it is possible that some of your readers may have obtained copies of the papyrograph report of my lectures on "Molecular Dynamics," delivered at Baltimore during October, 1884, I should be obliged by your giving publicity to the following corrections:—

Page 34, lines 18 and 19.—*Delete* "we may call it a dynamox but not a paradox." I have no recollection nor can I imagine what the word was that I suggested as more logical than "paradox"!

Page 59, line 14.—*For* "Distortional" *substitute* "Condensational."

Page 296.—In the two expressions for ψ, given in equation (17), *insert* "tan i" before "$\frac{(\mu^2-1)^2}{\mu^2+1}$"; also, in the expressions *for* "tan ε" and "tan ε_1" of equation (20) *insert* "tan i" before "$\frac{(\mu^2-1)^2}{\mu^2+1}$." The formula from which these expressions are deduced is correctly given at the foot of page 295.

Page 296.—In line 13 from the top of the page, and in the left hand members of equations (19) and (21), *for* "ω" and "ω_1" *read* "$\bar{\omega}$" and "$\bar{\omega}_1$" respectively.

WILLIAM THOMSON.

The University, Glasgow, February 27.

[From *Nature*, No. 805, April 2, 1885].

I think there must be some mistake in Prof. Forbes' report of Sir Wm. Thomson's remarks, as quoted in *Nature* of last week (p. 461) upon the rate of wave-propagation on Maxwell's electro-magnetic theory of light. From the end of the last quotation one would suppose that Sir Wm. Thomson intended to convey that the rate of wave-propagation that Maxwell's theory asserted to be the same as that of light, was the rate of propagation of a variation of a current in a conducting wire. Now Sir Wm. Thomson cannot, I am sure, have intended to convey any such mistaken notion. Maxwell carefully guards against any such mistake by pointing out that conduction of electricity is of the nature of diffusion, and not of a wave-propagation, and so has no definite velocity. What Maxwell has calculated is the rate of propagation of disturbances in *non-conductors*, and not in conductors. It is the rate at which the disturbances, produced in the way considered by Sir Wm. Thomson in the preceding part of this quotation, would be propagated by transverse vibrations. Of course, as Sir Wm. Thomson asserts, something analogous to a longitudinal vibration may co-exist with these, but Maxwell's theory shows that a medium which would transmit only transverse vibrations would explain electric and magnetic phenomena.

GEO. FRAS. FITZGERALD.

40, Trinity College, Dublin, March 23.

[The passage quoted by Mr. Forbes is correctly reported. A more full explanation of this subject will be found in Nichol's "Cyclopædia," second edition, 1860, article "Electricity, velocity of;" reprinted in vol. ii, art. lxxxi, of my collected mathematical and physical papers.—W. T.]

Additional correspondence on the same subject is given in *Nature*, No. 810, May 7, 1885.

Sir Wm. Thomson's lectures, p. 276, lines 21, 22 from the top.—*For* ground glass and plain glass *read* crown glass and flint glass. A. S. H.

CORRESPONDENCE.

Extract from a letter from Mr. J. HAMMOND, Buckhurst Hill, Essex, England, *to* Dr. CRAIG.

May 18, 1885.—. . . I send herewith a complete set of syzygies for the Quintic, for publication in the *American Journal of Mathematics*. I have other results to follow, viz., expressions of the fundamental semi-invariants of the Quintic in terms of those of the Sextic, or say formulae of reduction from the Quintic to the Sextic; only the formula of reduction for the Skew Invariant remains to be calculated. Then there is the enumeration of the second syzygies of the Quintic, *i. e.* the linear relations connecting the compound syzygies. Of these there is an enormous number. I have catalogued (enumerated and named) more than 1600 of them all irreducible and hundreds more remain to be catalogued. Beyond these there are third, fourth, &c., eighteenth syzygies for the Quintic, and similar results to be obtained for the Sextic, only here there are second, third, . . . twentieth syzygies. There is, therefore, enough to do to finish the theory of these Quantics without going on to the 7-ic, which I believe is full of interest. . . .

The paper I mentioned in my last letter, on Perpetuants with Applications to the Theory of Finite Quantics is only partly written out yet, it has been put on one side (but not forgotten) to make way for the present communication, for the results in which I claim absolute correctness. . . .

Extract from a letter from Mr. P. SEELHOFF, of Hamburg, *to* Dr. CRAIG.

June, 1885.—. . . Ausserdem geht Ihnen aber noch eine andere Arbeit von mir zu, auf die ich ganz besonderen Wert lege, da ich in ihr eine von mir gefundene Lösung des Problems, grosse Zahlen *leicht* in ihre Faktoren aus zulösen, gebe. Herr Prof. Bouniakowsky in St. Petersburg hat mir von den Arbeiten des Herrn E. Lucas in dem Am. Journal geschrieben; ich kenne diese leider noch wenig, doch werde ich in der nächsten Zeit mich mit seiner Théorie des fonctions simplement périodiques, ein Werk welches die hiesige Stadt-bibliothek auf meinen Antrag hin bestellt hat, beschäftigen. Es ist ja wohl ein Abdruck aus Ihrem Journale.

Zu dem Resultate, welches Herr Lucas für die Zahlen $2^{41}-1$ ets erlangt hat, bin ich auch gekommen, ohne Kenntniss davon zu haben; auch die Zerlegung von $2^{64}+1$ durch Herrn Lundry habe ich selbständig gefunden; ich weiss nicht, ob es bekannt ist, dass auch der grössere Faktor in diesem Falle eine Primzahl ist. Ich kann dies nachweisen. . . .

REPORTS OF RECENT COMMUNICATIONS TO THE UNIVERSITY SOCIETIES; AND OTHER SCIENTIFIC NOTES.

On a new Group of Vedic words belonging to the root praç, "to ask." By M. BLOOMFIELD.

[Abstract of a paper read at a meeting of the University Philological Association, May 8, 1885].

The hymn Atharva-Veda, ii, 27, has been translated and misunderstood three times by Weber, Ind. Stud., xiii, 190; Ludwig, Der Rig-Veda, vol. 3, p. 461; and Grill, 100 Lieder des Atharva-Veda, p. 16. All three translators err because they regard the words *prā́ç* and *prátiprāç* as derived from the root *aç* "to eat," and the preposition *pra*; they are thus led to regard the hymn as an incantation against robbers of provisions, pronounced in order to protect granaries, cupboards, and the like.

We can omit the verses which contain the refrain: *prā́çaṁ prátiprāço jahi*, etc., as they do not add to the general sense of the hymn. There are left verses 1 and 7:

né ' c chátruḥ prā́çaṁ jayāti sáhamānā ' bhibhū́r asi,
prā́çaṁ prátiprāço jahy arasā́n kṛṇv oṣadhe.
tásya prā́çaṁ tvā́ṁ jahi yó na indrā ' bhidā́sati,
ádhi no brūhi çáktibhiḥ prāçí mām úttaraṁ kṛdhi.

The scholars mentioned above translate about as follows:

1. "May the enemy not rob my provisions! thou art mighty and victorious (o *pāṭā*-plant)! Strike those who damage my provisions, make them feeble, o plant!
7. Destroy, o Indra, the provisions of him who is hostile to us; favor us with your might; make me uppermost in provisions!"

I propose the following translation which is based upon the conviction that the hymn has nothing to do with provisions, granaries, and the like, but is an incantation made against a parliamentary opponent before entering upon a debate in the *sabhā* or *pariṣad*, the assembly of the village:

1. "May the enemy not win the debate! thou art mighty and overwhelming (o pāṭā-plant)!
   Overcome the debate of those who debate against us! render them stupid!
7. Do thou overcome the debate of the one who is hostile against us, o Indra
   Do thou encourage us with your might; render me superior in dispute."

The ground for this deviation from the authorities in the exegesis of the hymn is a passage in the Kāuçika-sūtra in which this hymn is cited. It occurs in the 38th chapter, sūtras 17 fg.

Sūtra 17: iyaṁ vīrud iti (i. 34) *madugham khādann aparājitāt pariṣadam āvrajati.*

Dārila: janasamūhaṁ jyeṣthī madhukam bhakṣayan āvrajane mantraḥ . . . pratyarthajapadoṣaçamanaṁ prāyaçcittam.

Evidently the scene is the village-assembly. The eldest of the village, who presides in the assembly approaches it chewing sweet-wood, in order that his voice may be persuasive. At the same time he praises the wood, from which he expects such beneficent influence. We are therefore prepared to find the next passage dealing with matters of the assembly.

The next sūtra, which cites our hymn, reads as follows:

Sūtra 19*: ne ' c chatrur iti pratiprāçitam.* I translate: "With the hymn ii, 27, 1, he approaches the one who is assailed in debate (*i. e.* his opponent), from a north-easterly direction while chewing *pāṭā*-plant."

Dārila: pāṭāmūlam khādann aparājitāt pratiprāçitam āvrajati.

Sūtra 19: *anvāha.* I translate: He pronounces the hymn ii, 27, against his opponent.

Darila: *prativādinam anvāha.*

It is quite evident that the scholiast glosses the word *pratiprāçitam* by *prativādinam*. *Pratiprāçitam*, which is simply marked with an interrogation sign in the new Sanskrit lexicon of the Petersburg Academy, is therefore a quasi-denominal passive participle from *prátiprāç* (Whitney, 1176 ^{b}), one affected by a *prátiprāç*, by a counter-argument.

We gain in this manner three words from the root *praç*:

Prā́ç, acc. *prā́çam*, loc. *prāçí*, debate, dispute, in the same sense as *praçna*. It is formed exactly like *vā́c*, loc. *vācí*, from root *vac*.

Prátiprāç, "having a dispute against," controverser, disputant, enemy.

Pratiprāçita, "affected by or attacked by dispute, controversy."

The word *prāç* occurs once more in the same chapter of the Kāuçika, and here it is even more clearly not to be derived from the root *aç* "to eat" with the preposition *pra*, but comes from *praç* "to ask."

The passage reads as follows: *brahma jajñānam iti adhyāyān upākariṣyan abhivyāhārayati.* I translate: "When about to begin the reading of a Veda-lesson he (*i. e.* the teacher) lets (them *i. e.* the pupils) recite the hymn AV., iv, 1."

Dārila: *upākarmasu çiṣyān abhivyāhārayati sūktam; kalahaparihāra (! for parihāsa) doṣanāçāt prāyaçcittatvaṁ.* "An expiatory proceeding for the purpose of counteracting the evil effects of quarrels and unseemly merriment (in the school)."

The next sūtra read: *prāçaṁ kathayiṣyan.* I translate: "Also when expounding (to the pupils) a disputed question, he lets them recite the first hymn."

Dārila: *pratipraçnaṁ kathayiṣyan.* Here Dārila glosses *prāç* distinctly by *pratipraçna.*

Note on the Study of Sanskrit and Comparative Philology. By M. BLOOMFIELD.

The study of Sanskrit with its close companion Comparative Philology at present not only claims the attention of the specialist, the Indian philologist, and the student of linguistic science, but ought to form an essential portion of an historical education, or even a liberal education in general. To begin with the vast peninsula, a small continent in itself, with its 225 millions of inhabitants, even if considered aside from the rest of the world, cannot fail to be interesting because of the very considerable part (about one-fifth) of the human race which it contains. Yet this constitutes its smallest claim upon the attention of educated men. The real reason why India is and must continue to be studied lies in the fact, that it is in so many senses a part of ourselves, that it contains the reflex, or even better an important version of the life of the peoples of Europe, of their literatures, their ancient religions, laws, manners and customs, and their languages. At least a thousand years before Christ India was invaded by successions of Aryan tribes, who succeeded finally in becoming masters of the entire peninsula. They brought with them a rude civilization, which in all leading respects reflects in a more archaic form the early life of the leading nations of Europe, the Greeks, Romans, Teutons, Celts, and Slavs. This they were left to develop peacefully for hundreds of years, undisturbed by serious invasions. In a literature preserved almost in full and continued in uninterrupted development, we are able to study the Aryan Indians, so as to obtain the most complete picture which we possess at all of any of the peoples of the Aryan race.

If we would understand the primitive religion of these peoples we must turn to the oldest Indian records, the Vedas, and study their mythology. The very names "Science of Religion" and "Comparative Mythology" date from the opening out of the Vedic records. The study of house-customs, tales, fables, proverbs, folk-lore, superstitions, and the earliest forms of popular thought and feeling—materials which furnish a more vital constituent of history, than the schemes of courts and records of battles—these studies are indebted to India more than to any other source for their present vitality. The tales and fables which are familiar in the mouths of our people are ever and anon traced back to Indian Buddhistical sources, where they appear with undiminished or increased drollery and pathos, and the customs and manners deepest ingrained in popular habit can often be found systematically described in Indian books on house-law. The student of Historical and Comparative Jurisprudence finds in India laws rich in suggestions by their contrast as well as by their similarity to European law. The works of Sir Henry Sumner Maine, one of the most enlightened investigators in this field, bear witness on every page to the fundamental importance of Indian law in this most interesting and new field of research. Investigation into the sources and antecedents of all law and all government, based, as they must be, upon a study of the earliest and most fundamental forms of society, as *e. g.* the primitive village community, and the primitive patriarchial forms of government, are best carried on with the help of Indian records. And even to-day the best practical field of observation in this line are the still existing village estates in India, in which the germs of our own political history are still preserved to a considerable extent.

The study of the development of abstract religions and philosophical thought finds scope in India to an extent elsewhere unexampled in the history of man. Nowhere can we trace continuously under the guidance of native records, which often have preserved intact every link in the chain of development, the growth of a primitive simple polytheism into more abstract forms of religion. In India simple Vedic polytheism, philosophical Brahmanism, humanitarian Buddhism, and all the modern forms of Hindu religion are connected; we see them gradually grow one into another, or one out of another, so that even the most complicated facts can be traced back to their sources. The subtlest philosophy and the most naïve conceptions of primitive simple man hold each other by the hand. And the study of the literature of this vast period, if carried on in the right spirit, is full of human interest, full of lessons as good as can be derived from the study of the best European literatures. Max Müller, in a course of lectures delivered before the University of Cambridge in 1883 entitled "India, what can it teach us," (p. 6) says: "If I were asked under what sky the human mind has most fully developed some of its choicest gifts, has most deeply pondered on the greatest problems of life, and has found solutions of some of them, which well deserve the attention even of those who have studied Plato and Kant—I should point to India. And if I were to ask myself from what literature we, here in Europe, we who have been nurtured almost exclusively on the thoughts of Greeks and Romans, and of one Semitic race, the Jewish, may draw that corrective, which is most wanted in order to make our inner life more perfect, more comprehensive, more universal, in fact more truly human—again I should point to India."

But an even more important domain of knowledge, directly concerning the entire human race, being in fact the most primitive chapter of human history and human psychology, is opened out by the Sanskrit language. The study of Comparative Philology and the science of language carried on in any sense such as to deserve the name of a science, were unknown before the discovery of Sanskrit. By the aid of Comparative Philology there has been opened out a department, so to speak, of prehistoric history and ethnology, which lights up the past of our race, when all other records have given out. Language is the most faithful, passionless and conservative recorder of human history; a single word preserved to us from prehistoric times often reports a more essential fact than the most detailed chronicle. And if it is justly held that man himself and his mind are the truest and most important objects of human research, language, that gift which more than any other makes men truly human and holds them above all other created beings, that gift which is at once the sign and the means of man's superiority, is surely worthy of investigation. The science of language teaches us how we speak, why we speak in a given manner and not in another; it investigates the nature of the organs with which we speak, and studies the antecedents and the future of speech. Here again the ancient language of India has been of such fundamental importance, that the science may be said to have originated with the discovery of Sanskrit; all that preceded in this field of inquiry—which did not fail here and there to attract the fancy of the curious—was but as a disordered dream when compared with the lucid, definite and permanent results, which this science has yielded in its modern treatment, under the auspices of the strong light which has come from India.

On the Relative Value of the MSS. of Terence Collated by Umpfenbach. By E. M. Pease.

[Abstract of a paper read at a meeting of the University Philological Association, May 8, 1885].

Editors, when deciding upon the text of an author, are accustomed to grant a uniform value or rank to a MS. in all kinds of variations. It is but natural, however, that different scribes should have fallen into different kinds of errors, and that ancient editors should have changed the texts in some directions more than in others. If this is true, each MS. will have a certain individuality, and its variations will lie to some extent in particular grooves.

It was the purpose of this paper to show that in these MSS. of Terence, one MS. or family of MSS. should be regarded superior in one category of variations, and another in another.

Accepting Umpfenbach's text as a standard, the corrupt readings of the different MSS. were separated into many natural categories, such as the omission of verbs, of particles, of the different classes of pronouns, and of other words; the insertion of particles, and of other words; the changes in case, gender, number, mood, tense, person, division of verses, change of rolls, the substitution of one word for another, inverted order, and other similar categories. Then the number of errors of each MS. in each particular category was ascertained and its relative value determined.

Thus far the investigation, which has been carried through the Eunuchus and Adelphoe, has not only been fairly successful in assigning specific values to the various MSS. in the different categories, but it forces us to the conclusion that Umpfenbach, and others, have *greatly underrated an entire class.*

All scholars have agreed that the Bembinus (designated as A in Umpfenbach's edition) is the oldest and best MS. of Terence. Ritschl maintained that D belonged to the same family as A, and that possibly G did also, and he regarded D and G as greatly superior to PCBEF. Wagner asserts positively that D and G belong to the A family and always gives preference to those MSS. Umpfenbach recognizes that D and G do not belong to the A family and assumes that they fall under the Calliopian recension, but he has everywhere underrated the Parisinus family and regarded D as next to the Bembinus in value. Dziatzko is likewise prejudiced against the Parisinus family. The results of this work show that there are certainly three distinct families, and that E and F vary a great deal from the others of their class. In each category of omissions PCB have the fewest errors and A more than D; but in the cases of insertion, A is by far the best and PCB next. One of the most prominent categories is that in which one word is substituted for another. A has 204 such variations from the accepted text, P 213, C 245, B 250, F 267, E 306, D 318, and G 328.

There are 7 words in P so corrupted that they are not Latin forms, 20 in B, 30 in C, 36 in F, 44 in E, 46 in D, 67 in A, and 102 in G.

To show the changing of their values—A is first in the more important of these categories 10 times, the D and G family 2 times, and the P family 8 times. It is possible for a very good MS. to be first but few times and second many times. A is second 2 times, the D and G family 5 times, and the P family 19 times. A comparison of the sums of all the errors in each MS. will give a general idea of their values. It is as follows:

A	D	G	P	C	B	E	F
691	1094	1249	782	878	873	1056	981

The readings of the various correctors have also been classified, so that their values are known as definitely as those of the original MSS. Some correctors have improved their MSS., others have not. This investigation shows that the P family has the very highest authority in some kinds of variations, and that, in general, it is much more trustworthy than the DG family, and should be given greater prominence in establishing the text of Terence—especially in the *Andria* where A is wanting.

Because the text of Umpfenbach was taken as a standard, the odds have been against P in all these computations. This fact has additional force when considering the relation of P to A.

On the Catalogue of Old Testament Writings contained in the MS. of the Teaching of the Twelve Apostles. By Cyrus Adler.

[Abstract of a paper read at a meeting of the University Philological Association, April 3, 1885].

On the recto of the 76th leaf of the so-called Bryennios MS. there is inserted between the closing lines of the 2nd Epistle of Clement to the Corinthians, and the Teaching of the Twelve Apostles, a list of the Hebrew names of the books of the Bible, with their Greek equivalents. This list was published by Bryennios without any comment, and attention was early drawn to it. It contains some noteworthy peculiarities. The names of the books of the Pentateuch consist of the opening words of the different books, which corresponds to the usage in the Talmud and in Jerome. The list must have been copied, not directly from the Hebrew but from an Uncial text. Hence arose mistakes like *ἐμμονήλ* for *σεμμονήλ*; 'Οδοικρά (*λευιτικόν*) for 'Οαοικρά = Heb. וַיִּקְרָא; *Διαδδουδεμουήλ* (Βασιλειῶν β̄) for *Διδαδουδισεμουήλ* = Heb. דָּוִד וּשְׁמוּאֵל; *Δαμαλεώθ* (Παροιμιῶν) for *μαλσώθ* and this for *μασλώθ*; in the Bible משל has only a masculine plural, but Jerome preserves the feminine form Masloth, as does also the Talmud (cf. Sucah, 28, b, Baba Bathra, 134, a Synhedrin, 38, b). The *δι* which is prefixed to most of the books, is the Aramaic genitive particle די. The fuller form of the title was ספרא די = "book of," this we have partly preserved in the title of the book of Psalms, *Σφερτελίμ* = ספר תהלים. Other traces of Aramaic in this list are to be met with in the plurals in *σοφτιν* (Judges), in Heb. שֹׁפְטִים where Bryennios has read *σοτιην*, mistaking the scribe's correction of *μ* to *ν* for *η*, and in *Δεβριαμίν* (Chronicles) = Heb. דִּבְרֵי הַיָּמִים.

This list bears a great likeness to Jerome's Canon. Both mention the same books with the exception of Cinoth (Lamentations), which is not in this list. Both have an Aramaic plural for Chronicles, both prefix the word ספר to Psalms, both give Proverbs as a feminine plural and excepting a few evident vagaries both preserve substantially the same order. Certain it is that this list was taken from an Uncial MS. and not impossible that it is a copy of Jerome's Canon Aramaicized. It is a worthy companion of the early patristic tract in whose company it is found and furnishes no comfort to the forgery theory.

Pennsylvania Boroughs: A Chapter in the Municipal History of the State. By W. P. HOLCOMB.

[Abstract of a paper read at a meeting of the University Historical and Political Science Association, May 8, 1885].

This paper consists of three parts, the first on the growth of towns in Pennsylvania, the second on the early boroughs, and the third on the boroughs of this century. Under the first head are described Penn's methods of settling townships, villages, and his first "great towne." The various causes are discussed which aided or retarded the growth of towns, among them being the proprietary and legislative influence, the nature of the land system, the quit rents, establishment of internal communication and development of the natural resources. The influence of New Jersey's example in the settlement of the colony is also shown. The present importance of boroughs in the local government is seen by the large number of towns and villages that are incorporated as boroughs. In 1880 there were 549, with a total population of 713,714, ranging from 100 inhabitants to 13,940, and averaging 1,300. The antiquity of boroughs is noticed, also the frequent use of the word borough in the annals of English history, and the few instances where boroughs have appeared or been established in the United States.

In the second part the borough of Germantown, which existed from 1691 to 1707, is carefully analysed and compared with the English prototypes which it resembles more nearly than do any later boroughs. It had its bailiff as chief magistrate, four burgesses, commonalty, sheriff, recorder, general court of the corporation for passing laws, and its court of record for trying petty cases. Chester, Bristol and Lancaster were the only boroughs at the time of the revolution, and by 1800 there were eleven. Bristol on the Delaware is taken as a fair type of these.

The account of Bristol's government is based on its charter and its town records. It had its chief burgess as chief magistrate, and an assistant burgess; a town council to pass the ordinances and by-laws and to control the finances; a high constable, a pound keeper, and a few special officers appointed by the council. There was no bailiff, no sheriff or recorder, no court of the corporation, or court of record, as at Germantown, and a less restricted limitation of citizenship. The petty cases were tried either by the chief burgess, or a justice of the peace, or turned over by them to the county court. The chief magistrate in all the later boroughs has been a chief burgess or burgess. For a brief period he served as a justice of the peace in the county as well as in the borough. Boroughs never had separate representation in the Assembly. Occasionally boroughs held town meetings of the citizens to pass any unusual tax or measure. These were Pennsylvania's truest survivals of the folk-moot. Boroughs held their markets and semi-annual fairs. The fairs degenerated in morality, and were mostly abolished at the close of the last century.

The third part continues the development of the borough government under the various acts of legislature, the two most important borough acts being those of 1834 and 1851. Until 1834 all boroughs were specially incorporated by the Assembly. This law extended the same authority to the county courts of quarter sessions. In 1874 special legislation ceased on the adoption of the new constitution. Boroughs can only be incorporated by the courts, and cannot secure special privileges from the legislature. The acts of 1834 and 1851, together with some briefer ones, now form the general borough law. Most boroughs are under these laws; a few still preserve their old charters, though with modifications. Boroughs not divided into wards generally elect a burgess, a council of six, a constable, one or two assessors, and three auditors. The council appoints its secretary, a treasurer, and other necessary officers. The regulations for electing justices of the peace, school directors, and overseers of the poor, are the same as in the township. The relations of borough and township to the county are the same, each being under the county courts, and each paying county taxes at the same rates.

This important subject of the origin of the "compromise" system of government is also discussed in the paper, and attention is called to New Jersey's institutional development in the 17th century, as the key-note to the relations of county and township in Pennsylvania.

On the History of American Literature relating to Money, Credit, and Banking. By D. R. DEWEY.

[Abstract of a paper read at a meeting of the University Historical and Political Science Association, May 15, 1885.]

This constituted one chapter of a series which treats of the history of American economic literature. These bear the following titles: (1) General considerations which have governed economic inquiries in the United States, previous to the time of Henry C. Carey; (2) The history of the literature in regard to money, credit, and banking; (3) The history of the literature illustrating the opinions maintained in regard to the relations of government with trade and manufactures, and also concerning the modes of taxation; (4) The history of the literature relating to labor, the relations of state and labor, socialism and communism; (5) History of opinion concerning population, pauperism, and charities. These chapters form one part of the work now in progress on the "History of Economic Thought in the United States."

In the chapter presented, an attempt was made to give a picture of American thought on the nature of money, beginning with early colonial times. It was considered distinct from a history of finance in that it represented opinion, and not administration. The sources, employed for this purpose, were the early pamphlets, published in Philadelphia and Boston, beginning with the year 1685; the writings of Dr. Douglass, Tench Francis, Franklin, Pelatiah Webster, Paine, Gale, and others of the Revolutionary period; and the monetary opinions of Morris, Jefferson, Hamilton, and Adams, as revealed in their correspondence and official reports. The various unique theories of the decade following the downfall of the Second United States Bank were briefly characterized, and special attention was directed to the works of Prof. Tucker, Cordy Raguet, and Stephen Colwell, who were considered as standing for the most valuable thought of this period. For the later period, the writings of the hard money school, represented by the Walkers, Professors Bowen and Sumner, were summarized, and finally the theories of the so-called fiat money writers were analyzed in their various forms.

The plan throughout the investigation was to examine not only the larger works but to sift the monetary opinions as expressed in pamphlets and ephemeral form, and to indicate the influence of geographical and class environment in shaping the theories held. In conclusion, the writer suggested that the unsettled life of the early Americans might naturally destine them to incomplete notions on the functions of money; and with the removal of old standards, it was perhaps natural that Americans should emphasise the exchange function of money. This with the thorough-going opinions in regard to the sovereignty of a democratic people, joined with the unconscious absorption of Carey's idea that the chief duty of money was to serve as the instrument of association, led to the one-sided thinking expressed in our literature.

The Elene and Cynewulf. By W. E. Gates.

[Abstract of a paper read at a meeting of the University Philological Association, May 8, 1885].

The investigation was directed to the possibility of finding the original MS. from which Cynewulf translated the Elene, and the results of such a discovery. A comparison with the text of the Acta Sanctorum shows beyond a doubt that the translation was made with the Latin lying open in front. The number of passages showing this is some fifty or sixty. Cf. especially fore scéawode for providebam, l. 345; also ll. 144–7, 294, 298, 393, 457, 464, 1111. Variations inconsistent with copying are about thirty; of these two-thirds are matters of fact, where failure to follow the original is most unlikely; cf. l. 1228. Of the fifteen more important ones, in six the Elene reading is sustained by other Latin texts at hand, in such way as to warrant positing an original agreeing with the Elene in all essential points. These differences are of such a character as almost to preclude the idea of two unconnected MSS. agreeing throughout, and to establish that an existing MS. following the Elene readings must go back to Cynewulf. Such a one might be found traceable, either itself or in its ancestry to Peterborough, when it would speak for *that* Cynewulf. Should, after a like investigation has constructed the Latin original of the Gûthlâc, Andreas, etc., a MS. be found containing several of these lives, in this form, it would evidence a common author for them. Query:—What do MSS. Paris Nat. n. acq. lat. 2180, and Cotton Nero, E. 1, show?

Note on a Quadratic Form. By F. Cajöri.

[Abstract of a paper read at a meeting of the University Mathematical Society, May 20, 1885].

Let (a, b, c) denote a binary quadratic form of negative determinant wherein $2b$ contains neither a nor c. We shall consider the possibility of transforming such a form (a, b, c) by the substitution $\binom{\lambda,\ \mu}{\nu,\ \rho}$ into the form $(a', 0, c')$. We get

$$\left.\begin{aligned} a\lambda\mu + b(\lambda\rho + \mu\nu) + c\nu\rho &= 0, \\ \lambda\rho - \mu\nu &= \pm 1, \end{aligned}\right\} \quad (1).$$

Eliminate λ and solve for μ. The condition that μ be real is that the quantity under the radical sign be equal to or greater than zero. Whence $a^2 \geqq 4\nu^2\rho^2\Delta$, where Δ stands for the absolute value of the determinant. On eliminating ν from (1) and solving for ρ we get in the same way $c^2 \geqq 4\mu^2\lambda^2\Delta$. These two conditions must be satisfied in order that the transformation be not impossible. We notice that ν and ρ cannot be zero at the same time, nor can μ and λ. It is furthermore impossible for these coefficients of substitution to be zero, one at a time, for then it would follow from (1) that b contains either a or c,—a case contrary to assumption. Therefore, unity is the minimum absolute value which these coefficients can have; hence, if the conditions $a^2 \geqq 4\Delta$ and $c^2 \geqq 4\Delta$ are not satisfied, we *know at once* that the transformation is impossible. If they are satisfied, then we obtain the upper limits for the products $\nu^2\rho^2$ and $\mu^2\lambda^2$. Suppose, for instance, that $a^2 < 36\Delta$, then $\rho^2\nu^2 < 9$. If any one of the set of values which ν and ρ can have, renders, when substituted in (1), μ and λ integral, then the transformation is possible; otherwise it is impossible.

PROCEEDINGS OF SOCIETIES.

Scientific Association.

May 6.—Sixty-fifth regular meeting. Professor Rowland in the chair. Thirty-seven persons present.

Papers read:

A Comparison of Sight and Touch, by J. Jastrow.
The Recent Discovery of Thiophene, by I. Remsen.
An Account of Juincke's Experiments on Hydrostatic Pressure in a Magnetic Field, by H. Crew.
New Forms of Laboratory Apparatus, by C. W. Hayes.

Philological Association.

May 8.—Sixty-second regular meeting. Professor Gildersleeve in the chair. Thirty-two members present.

Papers read:

On Some Old Glosses in Codex Sangallensis 912, by M. Warren.
On the Codex Martinianus of the New Testament, by J. R. Harris.
On a New Group of Vedic Words, belonging to the Root *praç*, by M. Bloomfield. (*Abstract on p.* 119.)
Some Notes on the Elene and Cynewulf, by W. E. Gates. (*Abstract on p.* 122.)
On the Relative Value of the MSS. of Terence Collated by Umpfenbach, by E. M. Pease. (*Abstract on p.* 120.)

Historical and Political Science Association.

April 24.—Dr. H. B. Adams in the chair.
Village Communities on the Delaware, by T. K. Worthington.

May 1.—Dr. H. B. Adams in the chair.
The Puritan Colony at Annapolis, by D. R. Randall.

May 8.—Dr. H. B. Adams in the chair.
The Negro in Mississippi Politics, by F. A. Bancroft.
Pennsylvania Boroughs, by W. P. Holcomb. (*Abstract on p.* 121.)

May 15.—Dr. H. B. Adams in the chair.
What Became of the Northern Slaves, by Leigh Bonsal.
American Literature Relating to Money, Credit, and Banking, by D. R. Dewey. (*Abstract on p.* 121.)

May 22.—Dr. H. B. Adams in the chair.
Free Negroes in Maryland, by J. R. Brackett.

Mathematical Society.

May 20.—Professor Newcomb in the chair. Ten persons present.

Papers read:

Note on the Development of Rational Fraction in Partial Fractions, by W. E. Story.
Note on a Quadratic Form, by F. Cajöri. (*Abstract on p.* 122.)

Baltimore Naturalists' Field Club.

March 18.—Dr. Williams in the chair. Twenty-two members present.

Address by Professor Martin on the importance of field club work.

Dr. Brooks spoke of the difference between fertilization of a domestic flower by wild pollen of the same species, and the fertilization of the wild flower by the pollen of the cultivated plant of the same species.

Mr. Lugger read a paper on "Instincts in insects not infallible," showing that the tachyna fly which parasitises the larva of a noctuid larva sometimes mistakes a snout beetle *sphenophorus 13-punctatus* for its legitimate host the noctuid larva, the two agreeing in color and frequenting the same plants. The eggs fastened upon the hard body of the snout beetle in consequence of this mistake do not find sufficient food for the development of the larvae.

Mr. Nelson made a report on plant lice and scale insects which he had found in the green houses during the winter. Most numerous and harmful was a black aphis, parasitic on chrysanthemum, and a scale on the leaves of camellias. The formation of these scales was explained, and specimens of *mytilapsis citricola*, imported in Florida oranges, were shown.

Mr. McMurrich spoke on the habits and structure of the Phytopti—a group of mites.

April 28.—Dr. Williams in the chair. Ten members present.

Mr. Lugger spoke of the usual belief that ants are fond of plant food, and stated that in some formicaries established by him they had shown a decided preference for animal food. He described the nest building of birds and showed that the methods of work are very simple, the bird using simply its beak and its own weight. The outlines of the nest being made by long hairs, threads, or blades of grass, the other material is piled in and felted together by the weight and movements of the body of the bird, projecting points being tucked in by the bill, but no use being made of the feet or wings. Mr. Lugger showed how a person with some experience could easily make an artificial nest that could not be distinguished from the true nest of a bird, by using a pair of pincers to imitate the bird's bill, and a test tube to imitate the pressure of its body in felting the material.

Mr. Lugger also described a hemipterous insect, *lygus pratensis*, found in the skunk cabbage and covered with its pollen, apparently concerned in the cross-fertilization of the plant.

Dr. Howell reported some work in the fertilization of Arbutus. The flower was found to be dichogamous, the anthers ripening first, soon after the opening of the flower, while somewhat later the style grows out beyond the corolla tube, and the lobes of the stigma open ready to receive pollen, after the pollen in its own flower has been discharged. Two species of humble bees and several small honey bees were found feeding in the flowers; on one of these large balls of the arbutus pollen were obtained. The nectaries of the flower are at the base of the corolla tube, and certain glandular hairs in the ovary may possibly serve this purpose also.

Mr. Donaldson exhibited some specimens of *viola bicolor*, in which the velvety surface usually confined to the two upper leaves had spread to the lateral leaves. He also spoke of the increase in coloring of the arbutus with increased altitude or latitude, and of the fact that young leaves are usually colored red.

May 27.—Dr. Williams in the chair. Thirteen members present.

Mr Lugger described a peculiar fungus parasitic on the ant which was discovered on one of the excursions. The fungus projects from the neck of the ant, is about one inch in length, and has a flattened disc in the middle. Attempts made to cultivate the fungus failed.

Mr. Donaldson exhibited specimens of the resting stage of a myxomycetes, and gave an account of the life history.

Dr. Howell spoke of the peculiar bract found on the flower of the linden tree. The usual belief that it shades the flower was shown to be incorrect. It probably serves to disperse the seed.

RECENT PUBLICATIONS.

REMSEN, IRA. An Introduction to the Study of the Compounds of Carbon or Organic Chemistry. (Boston: Ginn, Heath & Co., 1885, 374 pp., 12°).

"This book is intended for those who are beginning the subject. For this reason special care has been taken to select for treatment such compounds as best serve to make clear the fundamental principles. General relations as illustrated by special cases are discussed rather more fully than is customary in books of the same size; and, on the other hand, the number of compounds taken up is smaller than usual. The author has endeavored to avoid dogmatism, and to lead the student, through a careful study of the facts, to see for himself the reasons for adopting the prevalent views in regard to the structure of the compounds of carbon. Whenever a new formula is presented, the reasons for using it are given so that it may afterward be used intelligently. It is believed that the book is adapted to the needs of all students of chemistry, whether they intend to follow the pure science, or to deal with it in its applications to the arts, medicine, etc. It is difficult to see how, without some such general introductory study, the technical chemist and the student of medicine can comprehend what is usually put before them under the heads of 'Applied Organic Chemistry' and 'Medical Chemistry.'

"Without some direct contact with the compounds considered, it is difficult to get a clear idea regarding them and their changes. A course of properly selected experiments, illustrating the methods used in preparing the principal classes of compounds, and the fundamental reactions involved in their transformations, wonderfully facilitates the study. The attempt has been made to give directions for such a course. More than eighty experiments which could be performed in any chemical laboratory are described; and it is hoped that the plan may meet with approval. The time required to perform a fair proportion of these experiments is not great; and the results in the direction of enlarging the student's knowledge of chemical phenomena will, it is firmly believed, furnish a full compensation for the time spent.

"The order in which the topics are taken up will be found to differ somewhat from that commonly adopted. The object in view was, however, not to find a new method, but to find one which would bring out as clearly as possible the beauty and simplicity of the relations which exist between the different classes of carbon compounds."—[*From the Preface.*]

AMERICAN JOURNAL OF PHILOLOGY. Edited by Professor Gildersleeve, Vol. V, 4. (Whole No. 20). Baltimore, December, 1884.

Article I.—The New Revision of King James' Revision of the New Testament. IV. *Examination of the Revision of S. Matthew (continued).* By CHARLES SHORT.

This number of Professor Short's examination brings us to the close of c. xviii. Incidentally many points of usage in English are discussed, such as *that which*, the tmesis of *soever*, *till* = *while*, the attraction of the relative, the double adverbs *clean, cleanly; clear, clearly; deep, deeply; exceeding, exceedingly*, etc.

Article II.—Collation of the British Museum MS. Evan. 604 (*For St. Luke*). By W. H. SIMCOX.

This MS. has such a remarkable text that Mr. Simcox thinks it desirable to lose no time in recording what has been already observed of it. The standard of Mr. Simcox's collation is Stephens' text reprinted by Scrivener. The noteworthy readings are far more numerous in the first half of the Gospel than in the second. In the first four chapters there are about 60 cases where 604 agrees, against the received text, with the approximate consensus of the group of authorities to which ℵBL. 33 belong; about 80 where it agrees with the T. R. against those and some 40 odd, where it differs from the T. R., and is supported by *some* ancient authority (usually "Western") other than that mentioned. On the other hand, in the last four chapters (218 verses compared with 232) there are (besides mere clerical errors and varieties of spelling) only 35 deviations in all from the received text; and of these, 7 are cases where the modern "Received Text" is a merely accidental one, not agreeing with the mass of even the later codices.

Article III.—Professor Child's Ballad Book. By THOMAS DAVIDSON.

"The care and trouble which [Professor Child] has expended in hunting up texts, and the number which, in some cases, he has discovered, are matters deserving of all admiration," says Professor Davidson in the opening of his article, and at the close of it he speaks of "the charming volume in which rare scholarship is so happily blended with the still rarer evidence of power to enter into the feelings of people who accepted the stern facts of life without question, and who had not risen to that self-consciousness which is at once our glory and our 'death-naming.'" In the course of his appreciative review, Professor Davidson has occasion to make corrections and additions from his own personal acquaintance with the source of ballad poetry—the people.

Article IV.—The Relation of a Greek Colony to its Mother-City. By C. D. MORRIS.

Professor Morris shows that the assertion of Curtius "that colonies were, according to the most ancient usage, universally obliged to settle their legal disputes in the mother city" is neither supported by the authorities C. seems to cite in favor of it, nor sanctioned by the other writers who have treated of the subject or by the authorities quoted by them.

Article V.—Anglo-Saxon Glosses to Boethius. By JAMES W. BRIGHT.

Description of MS. No. 204 in the library of Corpus Christi College, with a few specimen pages—all due to the kindness of Prof. Skeat.

Article VI.—Semitic Notes. By PROFESSOR CRAWFORD H. TOY. 1. *On Assyrian Case-endings.* 2. *The Syllable in Hebrew.*

In the first chapter Professor Toy shows first that there was greater license in the employment of *u* than in that of the other case-endings (*i* and *a*), and secondly that the license increased with time. In the second chapter it is argued that there is considerable practical advantage in recognizing Š^{e}wā as an individual independent vowel.

In the *Notes* Prof. WARREN gives as the etymology of "hybrid" Lat. *hybrida*, ὑ + ἰβρο = *sus* + *aper*, the progeny of a sow and a wild boar (see *University Circular* 38, p. 65) and Prof. DAVIDSON reads in Herakleitos Fr. xxxvi (Bywater); 86, 87 (Mullach) ἀλλοιοῦται δὲ ὅκως πῦρ for the MS. ἀλλ. ὅκωσπερ.

This number contains *Reviews* of *Christ's Homeri Iliadis Carmina, seiuncta, discreta, emendata, &c.* (by T. D. SEYMOUR), *Karl Krummacher's Beiträge zu einer Geschichte der griechischen Sprache* (by ALFRED EMERSON), *Vietor's Elemente der phonetik und orthoepie des Deutschen, Englischen u. Französischen* (by A. M. ELLIOTT), *Gomperz's Ein unbekanntes Griechisches Schriftsystem*, and *Wessely's Prolegomena ad papyrorum Graecorum novam collectionem edendam* (by J. RENDEL HARRIS), and a notice of *Holden's Xenophon's Oeconomicus* (by B. L. G.).

The *Reports* give abstracts of *Philologus, Zeitschrift der deutschen morgenländischen Gesellschaft, Mnemosyne*, and *Rheinisches Museum*. *Brief Mention.*

Vol. VI, 1, (Whole No. 21). Baltimore, April, 1885.

Article I.—The Ephebic Inscription of C. I. G. 282, Lebas, Attique, 560, and C. I. A. iii, 1079. By A. C. MERRIAM.

This inscription is given with a photograph, reproduced by the artotype process. All the previous publications had been from a copy made by Fourmont at Athens, but this copy contained so many errors that it has been thought worth while to republish the inscription from the original stone, which has been in the possession of Columbia College for forty-five years at least. The current readings are very plain on the stone and confirm in the main the conjectures of the editors. A mortuary stele is also described.

Article II.—The I-Sound in English. By G. H. BALG.

The object of this paper is to prove the independent development of the *i*-sound in English, *i* as "fish," "bit," "meet," "eat." Dr. Balg thinks that he has made it evident that all so-called change of the sound of *i* in English, no matter of what origin, took place under definite conditions, and that these conditions did not lie outside of, but within the sphere of the English language; that the impulse for the development and decay of that sound was given by homogeneous elements, that is to say, by the nature of the English language itself.

Article III.—Conflate Readings of the New Testament. By J. RENDEL HARRIS.

The study of transcriptional errors belongs to the paleographer first and the general critic afterwards. Now the principal motions of a scribe's eye are mechanical motions, right and left and up and down. The vertical error, however, is patent in the omission in almost every written document of lines of the copy; lateral errors have often, if not generally, escaped detection. The recognition of the existence of such a source of error in columnar texts—which Professor Harris proceeds to substantiate—affords great assistance to the restoration of the early text forms, and in the intimately connected problem of the genealogy of the witnesses that are left to us, as the paper shows in detailed application to the text of the N. T. and the eight "conflate readings" of Dr. Hort.

Article IV.—Four Etymological Notes. By MAURICE BLOOMFIELD.

In these notes Professor Bloomfield undertakes to establish Latin *usque* = Vedic *ácchă*; (2) to discriminate between *πέπων* "ripe" and *πέπων* "mild, weak;" (3) to set up probable equivalents of the Greek *ἀρ*, *ῥά* in the Sk. *-thi* (*tárhi*, *yárhi*) and to indentify *ἀμβλακεῖν* with Sk. *mlecchati*. (See *University Circulars*, Nos. 36 and 13).

Article V.—The Final Sentence in Greek. By B. L. GILDERSLEEVE.

This article completes a study begun in Vol. III, No. 4 (Whole No. 16), (see *University Circular* for April, 1884). Like the preceding paper it takes the form of a review and summary of the work of Weber and Schanz, and as in the case of the preceding paper the multiplicity of detail forbids summary. Among the important points discussed are the limitation of *ὡς*, the use of *ὅπως* with the first aor. subj., the variation in the sequence of moods and tenses in periods and in authors.

In the *Notes* Professor HENRY LANG adds a number of Spanish metaphors to Dr. Brinkmann's collection in the *Studien über den Geist der modernen Sprachen*, 1 *Bd.*, *Die Thierbilder der Sprache*, and brings some further illustrations to the laws of *Spanish Grammar*. In Plato's Theait. 169 D.: *καὶ ἡμὶν ξυνεχώρησεν ὁ Πρωταγόρας* Prof. W. A. LAMBERTON considers *ἡμῖν* as not dependent on *ξ.*, but as the indefinite dative of the person interested in the statement "whether we were right or wrong in supposing that Protagoras did"—citing for *συγχωρέω* without a dative and with the accusative and inf. Rep. 6, 489 D., for the free dat.; Theait., 1766 A.; 175 B.; Soph., 237 A.; Rep. 1, 343 A.

The *Reviews* relate to *Schuchardt's Slawo-Deutsches und Slawo-Italienisches* (A. M. ELLIOTT), *D'Ooge's Antigone* (J. H. WRIGHT), *The Common Tradition of the Synoptic Gospels, by E. A. Abbott and W. G. Rushbrooke, Spence, Bonet-Maury, Hitchcock and Brown's Edition of the Διδαχή, Gregory-Abbot's Prolegomena to Tischendorf's N. T.* (J. RENDEL HARRIS), *Keil, Analecta Isocratea* (B. L. G.), *Brünnow's Charidschiten unter den ersten Omayyaden* (C. H. TOY).

The *Reports* comprise *Mnemosyne, Hermes, Archiv für Lateinische Lexikographie u. Grammatik.*

Brief Mention (*Schenkl's Bibliotheca*).

Correspondence. Letter from H. A. J. MUNRO to ROBINSON ELLIS and a reply of TH. GOMPERZ to the strictures of Professor HARRIS in No. 20.

AMERICAN JOURNAL OF ARCHÆOLOGY. Vol. I., Nos. 1, 2, 3. Baltimore, 1885.

The object of the new Journal, besides giving a field for the original work of American and European archæologists, is primarily to furnish a medium in which all important work, done in the field which the Journal covers, should be concentrated, through correspondents in important archæological centres, and through a full record of the results of investigations carried on in all parts of the world. Reviews of recent publications, reports of the proceedings of societies, summaries of the contents of the principal archæological periodicals, and a full bibliography, are given, so as to make the Journal, as far as possible, a complete repertory of archæological work.

The advisory editor Professor CHARLES ELIOT NORTON, and the managing editor Dr. ARTHUR L. FROTHINGHAM, Jr. have the assistance of a staff of associate editors, each of whom is in charge of some special branch of work, like the Oriental, Classical, Christian, or American departments. No. 1 appeared in March, and Nos. 2 and 3 are now issued as a double number.

Vol. I., No. 1.

Article I.—The first American Classical Archæologist. By CHARLES ELIOT NORTON.

This paper relates to Mr. J. I. Middleton of South Carolina who travelled in Italy and Greece with Mr. Dodwell, the English archæologist, and published, in 1812, a volume on the prehistoric walls of Italy.

Article II.—The Panathenaic Festival and the Central Slab of the Parthenon Frieze. By CHARLES WALDSTEIN.

Wishing to give additional plausibility to the theory that the peplos on the Eastern frieze is not the sacred peplos of Athena, Dr. Waldstein brings out what is, according to him, the subject of the entire cycle, not the representation of any particular Panathenaic festival, but the Synoikia of Theseus as typifying the union of the Attic people.

Article III.—Inscribed Sepulchral Vases from Alexandria. By A. C. MERRIAM.

These vases, from an Alexandrian cemetery, contained the ashes of Greeks sent on some mission to Egypt who died while in that country. They are quite unique; many have inscriptions and a few have figure ornamentation. Their probable date, according to Prof. Merriam, is the reign of Ptolemy Philadelphos.

Article IV.—The revival of Sculpture in Europe in the Thirteenth Century. By A. L. FROTHINGHAM, Jr.

The development of sculpture in France and Italy through the Romanesque period is traced in this paper, and the superiority of France, as well as the continuity of her schools, is clearly brought out.

Article V.—Ancient Crude-Brick Construction and its Influence on the Doric Style. By A. R. MARSH.

The important result arrived at by Herr Doerpfeld in the essay on which this article is founded, is that the stone temples of the Doric style are not developed directly from wooden structures but from constructions in brick.

In the *Miscellanies* additional evidence is adduced concerning the work that *Arnolfo di Lapo* and *Jacopo Torriti* did in Rome c. 1300; and the certificate of decease of the noted architect *Antonio da San Gallo* is given. *Summaries* are given of the Gazette Archéologique, Revue Archéologique, Archäologische Zeitung, Mittheilungen, and Bullettino della Commissione Archeologica C. In the *Book reviews* Dr. Francis Brown emphasizes the lack of accurate and scholarly work shown in *William Wright's The Empire of the Hittites*, and Professor Norton points out the importance of *Salomon Reinach's Manuel de Philologie Classique.*

The News Department edited by Mr. T. W. LUDLOW occupies considerable space as it gives the greater part of the results of archæological investigations during the past year in Cyprus, Arabia, Asia Minor, Egypt, Tunisia, Algeria, Greece, Italy and France.

Vol. I., Nos. 2 and 3.

Article I.—The Aboriginal Relics called "Sinkers" or "Plummets." By HENRY W. HENSHAW.

These relics have received various names: sinkers, plummets, spinning-weights, sling-shots, ornaments, and bolas. The writer shows conclusively from his personal researches that none of the theories hitherto brought forward regarding these stones are correct, but that their most important use was as medicine-stones.

Article II.—The Lost Mosaics of Ravenna. By EUGÈNE MÜNTZ.

The writer, who has made a specialty of the history of Christian mosaics here completes our knowledge of the numerous cycle of the Ravenna mosaics.

Article III.—The Abbey of Jumiéges and the Legend of the Enervés. By CHARLES C. PERKINS.

The church, originally one of the most imposing structures of Normandy, was almost entirely destroyed at the time of the French Revolution. The XIII. century statues of the two young princes still remain to remind of the legend of the sons of Clovis.

Article IV.—Notes and Inscriptions from Asia Minor. By W. M. RAMSAY.

The first inscription makes known a society of the Ganymedeitai at Smyrna, the second, the ancient guild of the porters of Smyrna, while another gives occasion to an interesting discussion on the Oroandian people and their cities. The writer also makes some additions and corrections to Dr. Sterrett's Inscriptions of Assos.

Article V.—Two Modern Antiques. By ALFRED EMERSON.

A relief of the murder of Priam by Neoptolemos, accepted as a fine antique by O. Müller, E. Braun, and Heydemann, is shown to be a work of the Italian Renaissance, while everything seems to lead to the conclusion that the noted so-called archaic relief of Herakles drawing the bow, belonging to Mr. Carapanos, is the work of a modern forger.

In the *Miscellanies*, Dr. WILCOX illustrates Herr Doerpfeld's proposed restoration of the Propylaia; Prof. MERRIAM contributes some notes on early archæological subjects; and Mr. PERKINS brings forward an admirable drawing of one of the Siris bronzes.

The *Charvet collection of ancient glass in the Metropolitan Museum of Art, New York.* By W. H. GOODYEAR. This collection was one of the finest in Europe, and is especially valuable for its comprehensiveness and quality. Mr. Froehner's catalogue of it is the standard work on the subject of ancient glass. Prof. CYRUS THOMAS writes on the *Excavation of a mound in Tennessee*, and an *extract from a private letter of Dr. Ward from Babylonia*, gives some account of his itinerary. M. ERNEST BABELON contributes a long letter on *Carthage et l'archéologie Punique en Tunisie*, in which he reviews all that has been added of late, in the fields of discovery and literature, to our knowledge of Punic art. Mr. WM. H. DALL gives a *memorandum on the mounds of Satsuma and Enterprise in Florida.*

Reviews are given of *Perrot and Chipiez, History of Art in Phoenicia*, etc., by A. R. MARSH; of *Virchow, Alttrojanische Graeber und Schaedel*, and *Ueber alte Schaedel von Assos und Cypern*, by J. T. CLARKE; of the *Papers of the American School of Classical Studies at Athens*, by J. P. P. LONGFELLOW and A. EMERSON; of the *Second Annual Report of the Bureau of Ethnology*, by H. W. HENSHAW; of *G. B. de Rossi, D'un tesoro di monete Anglo-Sassoni*, and of *Marucchi, Di un antichissimo Orologio Solare*, by A. L. FROTHINGHAM, Jr.; of *C. Rau, Prehistoric Fishing*, by O. T. MASON; of *The British School of Archæology at Athens, Report*, by A. L. F., Jr., and of *Caruana, Discovery of a Tomb-cave, &c.*, by A. E.

The *Archæological News*, edited by Dr. A. L. Frothingham, besides giving this year's work, fills in many omissions of No. 1 for the discoveries in 1884. This season has been remarkable for the important discoveries made in Rome. *Summaries* are given of Archæologische Zeitung, Bulletin Monumental, Bullettino di Archeologia Cristiana, Bullettino della Commissione Archeologica C., Bulletin Trimestriel des Antiquités Africaines, 'Εφημερὶς 'Αρχαιολογικὴ, Gazette Archéologique, Jahrbuch d. K. Preussischen Kunstsammlungen, Journal of Hellenic Studies, Mittheilungen, Πρακτικά, Revue Archéologique, Revue de l'Art Chrétien. *Reports* of archæological societies of Great Britain, France, Germany, Italy, Russia, and United States. *Necrology. Bibliography.*

AMERICAN JOURNAL OF MATHEMATICS. Simon Newcomb, Editor; T. Craig, Associate Editor. Vol. VII, No. 4. Baltimore, July, 1885.

CONTENTS.

A Memoir on Biquaternions. By ARTHUR BUCHHEIM.

This paper contains a complete development of Clifford's Calculus of Biquaternions, especially as it is stated in his paper "preliminary sketch of biquaternions."

On the Syzygies of the Binary Sextic and their Relations. By J. HAMMOND.

The paper contains what the author regards as a complete set of formulae for the syzygies in question.

Reduction of Alternating Functions to Alternants. By WM. WOOLSEY JOHNSON.

On a Formula of Reduction for Alternants of the Third Order. By WM. WOOLSEY JOHNSON.

Bibliography of Linear Differential Equations. By H. B. NIXON and J. C. FIELDS.

This paper contains a list of titles of papers on the modern theory of linear differential equations as it has been developed by Fuchs and others.

The Addition-Theorem for Elliptic Functions. By WILLIAM E. STORY.

Formulae are given for the sn, cn, and dn of the sum of any number, odd or even, of arguments.

On the Calculation of the Cofactors of Alternants of the Fourth Order. By WM. WOOLSEY JOHNSON.

An extension of the theory of these functions as defined by Jacobi and subsequently developed by Muir and others.

Proof of a Theorem of Tchebycheff's on Definite Integrals. By F. FRANKLIN.

A simple proof of Tchebycheff's theorem concerning the superior and inferior limits of a definite integral. An extension of the theorem is also made by choosing arbitrary real limits for the integral instead of zero and unity.

Note on the Theorem $e^{ix} = \cos x + i \sin x$. By F. FRANKLIN.

A simple geometrical demonstration of the theorem.

CURRENT INFORMATION.

LOAN EXHIBITIONS OF WORKS OF ART.

During the past session, there has been a series of loan exhibitions, under the direction of the University Archæological Society, of works of art generously contributed by Mr. A. L. Frothingham, as follows:

November 22, 29, December 6.—*Original Drawings* by old masters of the Italian Schools, XVI to XVIII centuries.

December 13, 20.—*Photographs* of Italian Sculpture and Painting of the XV century.

January 10, 17.—*Photographs* of Italian Sculpture and Painting of the XIV and XVI centuries.

January 24, 31.—*Engravings* of Italian, French, German and British Schools of the XVIII and XIX centuries.

February 7, 14.—*Line Engravings* of portraits of all schools from the XVI to the XIX century (Italian, French, German, Flemish, Dutch and British.)

February 21, 28.—*Etchings* of Italian Schools from the XVI to the XIX century.

March 7, 14.—*Etchings* of Dutch, German, Flemish and French Schools.

March 28, April 4.—*Line Engravings* of Italian Schools from the XV to the XVIII century.

April 11, 18, 25.—*Line Engravings* of German, Dutch, Flemish, French and British Schools from the XVI to the XVIII century.

May 2, 9, 16.—*Original Drawings* by old masters of the Italian, French and Dutch Schools.

The *permanent Exhibition* consisted of fragments of Antique Sculpture, Etruscan and Italo-Greek Vases, and Egyptian Statuettes from the Cohen Collection.

RECENT APPOINTMENTS.

In the Johns Hopkins University.

GEORGE H. WILLIAMS, Ph. D.—Associate Professor of Mineralogy.

HENRY WOOD, Ph. D.—Associate Professor of German.

HENRY A. TODD, Ph. D.—Associate in the Romance Languages.

JAMES W. BRIGHT, Ph. D.—Instructor in English.

HENRY H. DONALDSON, Ph. D.—Instructor in Psychology.

(A list of the recent appointments to Fellowships and Scholarships is given on p. 126).

EDWARD H. KEISER, Ph. D.—Associate Professor of Chemistry, Bryn Mawr College, Pa.

WOODROW WILSON, A. B.—Associate in History, Bryn Mawr College, Pa.

LOUIS BEVIER, Ph. D.—Instructor in French, Rutgers College, N. J.

HOMER W. HILLYER, Ph. D.—Assistant in Chemistry, University of Wisconsin.

ALBERT G. PALMER, Ph. D.—Assistant in Chemistry, Swarthmore College, Pa.

CHARLES B. WRIGHT, A. B.—Professor of English Literature and Rhetoric, Middlebury College, Vt.

Professor H. NEWELL MARTIN was elected a Fellow of the Royal Society of London, at the annual meeting of the Society, June 4, 1885.

HONORS ANNOUNCED JUNE 11, 1885.

Doctors of Philosophy.

Edward Webster Bemis,* of Springfield, Mass., A. B., Amherst College, 1880. *Subjects:* History and Political Economy. *Thesis:* Local Government in Michigan and the Northwest.

Gustav Bissing, of Baltimore, A. B., Johns Hopkins University, 1882. *Subjects:* Mathematics and Physics. *Thesis:* Some Notes on Gauss' Coordinates and Steiner's Quartic Surface.

Henry Herbert Donaldson, of New York City, A. B., Yale College, 1879. *Subjects:* Animal Physiology and Histology; Vegetable Physiology. *Thesis:* On the Temperature Sense.

Louis Duncan, of Baltimore, U. S. Naval Academy, 1880. *Subjects:* Physics and Mathematics. *Thesis:* On the Determination of the Ohm by the Lorenz Method.

Homer Winthrop Hillyer, of Waupun, Wis., S. B., University of Wisconsin, 1882. *Subjects:* Chemistry and Physics. *Thesis:* Methods of Determining the Relative Stability of the Fatty Bromides.

Frederic Schiller Lee, of Canton, New York, A. B., St. Lawrence University, 1878, and A. M., 1881. *Subjects:* Animal Physiology and Histology, and Animal Morphology. *Thesis:* On Arterial Tonicity.

Gustav Adolph Liebig, Jr., of Baltimore, A. B., Johns Hopkins University, 1882. *Subjects:* Physics, Mathematics, and Chemistry. *Thesis:* On the Variation of the Specific Heat of Water.

James Playfair McMurrich, of Guelph, Canada, A. B., University of Toronto, 1879, and A. M., 1882. *Subjects:* Animal Morphology, Animal Physiology and Histology, and Vegetable Morphology. *Thesis:* The Osteology and Myology of *Amiurus catus.* (L.) Gill.

Albert Gallatin Palmer, of Baltimore, A. B., Johns Hopkins University, 1882. *Subjects:* Chemistry and Physics. *Thesis:* On the Conduct of p-Diazo-o-Toluene-sulphonic Acid toward Alcohol.

Harry Fielding Reid,* of Baltimore, A. B., Johns Hopkins University, 1880. *Subjects:* Physics and Mathematics. *Thesis:* On the Distribution of Energy in the Spectrum of Platinum at Different Temperatures.

Henry Alford Short,* of New York City, A. B., Columbia College, 1880. *Subjects:* Greek and Latin. *Thesis:* On the Development and Use of ὡς Final.

Morrison Isaac Swift, of Ashtabula, Ohio, A. B., Williams College, 1879. *Subjects:* Ethics and History of Philosophy, with Psychology and Political Economy. *Thesis;* On the Ethics of Idealism, as represented by Aristotle and Hegel.

Henry Alfred Todd,* of Baltimore, A. B., Princeton College, 1876. *Subjects:* Romance Languages and Sanskrit. *Thesis:* An *editio princeps* of an Old French poem, entitled "Dit de la Panthère."

Bachelors of Arts.

John Pendleton Campbell, of Charlestown, W. Va.
John Glenn, Jr., of Baltimore.
Junius Moore Horner, of Oxford, N. C.
James Albert Loane, of Baltimore.
Harry Wilbur Price, of Washington, D. C.
Benjamin Titus Roberts, Jr., of North Chili, N. Y.
Moses Roth Ryttenberg, of Baltimore.
Hugo Steiner, of Baltimore.
Henry Hazlehurst Wiegand, of Baltimore.

FELLOWS, 1885-86.

Cyrus Adler, of Philadelphia, A. B., University of Pennsylvania, 1883. *Shemitic Languages.*

Ethan A. Andrews, of New York City, Ph. B., Yale College, 1881. *Biology.*

David Barcroft, of Berkeley, Cal., Ph. B., University of California, 1882. *Mathematics.*

W. Shirley Bayley, of Baltimore, A. B., Johns Hopkins University, 1883. *Geology and Petrography.*

Louis Bell, of New York City, A. B., Dartmouth College, 1884. *Physics.*

Frank A. Christie, of Boston, Mass., A. B., Amherst College, 1881. *Greek.*

Henry Crew, of Wilmington, Ohio, A. B., Princeton College, 1882. *Physics.*

Davis R. Dewey, of Burlington, Vt., A. B., University of Vermont, 1879. *History and Politics.*

Albert E. Egge, of Decorah, Iowa, A. B., Norwegian Luther College, 1879, and A. M., 1884. *Teutonic Languages.*

William H. Emerson, of Tunnel Hill, Ga., U. S. Naval Academy, 1880. *Chemistry.*

John C. Fields, of Hamilton, Ont., A. B., University of Toronto, 1884. *Mathematics.*

Abel H. Huizinga, of Zeeland, Mich., A. B., Hope College, 1880, and A. M., 1883. *Shemitic Languages.*

Joseph Jastrow, of Philadelphia, A. B., University of Pennsylvania, 1882, and A. M., 1885. *Psychology.*

George T. Kemp, of Baltimore, A. B., Johns Hopkins University, 1883. *Biology.*

Gonzalez Lodge, of Baltimore, A. B., Johns Hopkins University, 1883. *Greek.*

Arthur McDonald, of Rochester, N. Y., A. B., University of Rochester, 1879. *Psychology.*

Charles S. Palmer, of Chicopee, Mass., A. B., Amherst College, 1879, and A. M., 1882. *Chemistry.*

Ernest M. Pease, of Boulder, Colo., A. B., University of Colorado, 1882. *Latin.*

Charles Whetham, of Toronto, Ont., A. B., University of Toronto, 1884. *Romance Languages.*

Charles B. Wright, of Akron, Ohio, A. B., Buchtel College, 1880. *English.*

UNIVERSITY SCHOLARS, 1885-86.

John P. Campbell, of Charlestown, W. Va., A. B., Johns Hopkins University, 1885.

Junius M. Horner, of Oxford, N. C., A. B., Johns Hopkins University, 1885.

Charles H. Howard, of Baltimore, A. B., Johns Hopkins University, 1884.

James A. Loane, of Baltimore, A. B., Johns Hopkins University, 1885.

William R. Orndorff, of Baltimore, A. B., Johns Hopkins University, 1884.

Henry V. Wilson, of Baltimore, A. B., Johns Hopkins University, 1883.

HONORARY HOPKINS SCHOLARS, 1885-86.

The following appointments have been renewed:

Edward C. Applegarth, of Baltimore.
William C. L. Gorton, of Baltimore.
Theodore Hough, of Virginia.
John H. T. McPherson, of Baltimore.
William F. Smith, of Baltimore.
Edward L. White, of Baltimore.
Allan C. Woods, of Baltimore.

Other appointments to scholarships will be made in the autumn.

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* The Degrees thus marked were conferred February 23; the others, June 11.

JOHNS HOPKINS UNIVERSITY CIRCULARS

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LIST OF PERIODICALS

Received by the Library of the Johns Hopkins University.

The following list gives the names of the periodicals (including the scientific and literary publications of the several societies, etc., sent in exchange with the University publications) now regularly received by the library of the University. In the case of journals, the title is given under the first word (not an article). The several institutions are arranged under their place of publication or their usual place of meeting. In a few cases, the titles are duplicated for facility of reference. The library also receives a large number of official reports, etc., that are not included in this list. The names of most of the newspapers received and of other ephemeral publications are also omitted. The whole number of serials received by the University exceeds seven hundred.

This list is supplemented by those of the Libraries of the Peabody Institute, the Maryland Historical Society, the Medical and Chirurgical Faculty, and other institutions of the city, so that the number of journals (not including newspapers, etc.) accessible to students exceeds nine hundred.

Academy. London.
Acta Mathematica. Stockholm.
Adelaide: Royal Society of South Australia: Publications.
Akademische Blätter. Brunswick.
Albany: N. Y. State Museum of Natural History: Publications.
Alemannia. Bonn.
Alienist and Neurologist. St. Louis.
Allgem. Bibliographie d. Staats-u. Rechtswissenschaften. Berlin.
Allgem. Bibliographie f. Deutschland. Leipsic.
American. Philadelphia.
American Academy of Arts and Sciences: Publications. Boston.
American Annals for the Deaf and Dumb. Washington.
American Antiquarian and Oriental Journal. Chicago.
American Antiquarian Society: Publications. Worcester, Mass.
American Assoc. for Advancement of Science: Publications.
American Bookseller. New York.
American Chemical Journal. Baltimore.
American Chemical Review. Chicago.
American Chemical Society: Publications. New York.
American Engineer. Chicago.
American Ephemeris and Nautical Almanac. Washington.
American Geographical Society: Publications. New York.
American Historical Association: Papers. New York.
American Institute of Mining Engineers: Transactions. New York.
American Journal of Archæology. Baltimore.
American Journal of Insanity. Utica, N. Y.
American Journal of Mathematics. Baltimore.
American Journal of Medical Sciences. Philadelphia.
American Journal of Pharmacy. Philadelphia.
American Journal of Philology. Baltimore.
American Journal of Science. New Haven.
American Medical Digest. New York.
American Meteorological Journal. Detroit.
American Museum of Natural History. New York.
American Naturalist. Philadelphia.
American Social Science Association: Publications.
American Oriental Society: Publications. New Haven.
American Philological Association: Transactions: Proceedings.
American Philosophical Society: Publications. Philadelphia.
Amherst, Mass.: Bulletin of Natural History.
Amsterdam: Royal Academy of Sciences: Publications.
    Royal Zoological Society: Publications.
Analyst. London.
Andover Review. Boston.
Anglia. Halle.
Annalen der Chemie (Liebig's). Halle.
Annalen der Physik u. Chemie, u. Beiblätter (Poggendorff's). Leipsic.
Annales de Chimie et de Physique. Paris.
Annales des Sciences Naturelles: Botanique. Paris.
Annales des Sciences Naturelles: Zoologie et Paléontologie. Paris.
Annales du Bibliophile Belge. Brussels.
Annali di Matematica Pura ed Applicata. Milan.
Annali di Statistica. Rome.
Annals of Mathematics. University of Virginia.
Annapolis: U. S. Naval Institute: Publications.
Annuaire de l'Association pour l'Encouragement des Études Grecques. Paris.
Antiquarian Magazine. London.
Apotheker Zeitung. New York.
Appalachia. Boston.
Archæolog.-Epigraph. Mitth. a. Oesterreich. Vienna.
Archæologische Zeitung. Berlin.
Archiv der Mathematik und Physik (Grunert). Leipsic.
Archiv f. Anatomie u. Physiologie. Leipsic.
Archiv f. d. Gesammte Physiologie, etc. Bonn.
Archiv f. d. Studien d. Neueren Sprachen u. Lit. Brunswick.
Archiv f. Eisenbahnwesen. Berlin.
Archiv f. Experimental-Pathologie. Leipsic.
Archiv f. Kirchliche Kunst.
Archiv f. Latein. Lexicographie u. Grammatik. Leipsic.
Archiv f. Literaturgeschichte. Leipsic.
Archiv f. Mathematik og Naturvidenskab. Christiania.
Archiv f. Mikroskopische Anatomie. Bonn.
Archiv f. Naturgeschichte. Berlin.
Archiv f. Oesterreich. Geschichte. Vienna.

Archiv f. Ohrenheilkunde. Leipsic.
Archiv f. Ophthalmologie. Leipsic.
Archiv f. Pathologische Anatomie. Berlin.
Archiv f. Psychiatrie u. Nerven-Krankheiten. Berlin.
Archives de Biologie. Ghent.
Archives de Physiologie Normale. Paris.
Archives de Zoologie Expérimentale et Générale. Paris.
Archives Italiennes de Biologie. Turin.
Archives Néerlandaises des Sciences Exactes et Nat. Harlem.
Archives of Comparative Medicine and Surgery. New York.
Archivio de Psichiatria, Scienze Penali, etc. Turin.
Archivio della Società Romana di Storia Patria. Rome.
Archivio di Letteratura Biblica ed Orientale. Turin.
Archivio Glottologico Italiano. Rome.
Archivio per le Scienze Mediche. Turin.
Archivio Storico Lombardo. Milan.
Archivio Storico per le Province Napoletane. Naples.
Asiatic Society of Bengal: Publications. Calcutta.
Asiatic Society (Ceylon Branch): Publications. Colombo.
Asiatic Society of Japan: Publications. Yokohama.
Association of Engineering Societies: Journal. New York.
Association Française pour l'Avancement des Sciences: Publications. Paris.
Astronomie (L'). Paris.
Astronomische Nachrichten. Kiel.
'Αθήναιον. Athens.
Athenaeum. London.
Athens: Deutsch. Archæol. Institut.: Mittheilungen.
Atlantic Monthly. Boston.
Avranches: Société d'Archéologie (Revue de l'Avranchin).
Ballad Society: Publications. London.
Baltimore: Maryland Historical Society: Publications.
    Medical and Chirurgical Faculty of Md.: Transactions.
Banker's Magazine. New York.
Barcelona: Associació d'Excursións Catalana: Publications.
Bay State Monthly. Boston.
Beiträge z. Gesch. d. Deutschen Sprach. u. Litt. Halle.
Beiträge z. Kunde d. Indogerm. Sprachen. Göttingen.
Beiträge z. Vergleich. Sprachforschung (Kuhn). Berlin.
Bergen (Norway): Museum: Publications.
Berichte der Deutschen Chemischen Gesellschaft. Berlin.
Berliner Studien f. Classische Philol. u. Archæologie. Berlin.
Berlin: K. Preuss. Akademie der Wissenschaften: Publications.
    Deutsche Chemische Gesellschaft: Berichte.
    Deutsche Shakespeare Gesellschaft: Jahrbuch.
    Preuss. Statistisch. Bureau: Zeitschrift.
Berliner Philologische Wochenschrift. Berlin.
Berne: Schweiz. Gesellsch. f. d. Gesammt. Wissenschaften: Publications.
Bibliografia Italiana. Milan.
Bibliographie de la France. Paris.
Bibliotheca Indica (all series). Calcutta.
Bibliotheca Sacra. Oberlin, Ohio.
Birmingham: Philosophical Society: Transactions.
Boletin Folklórico Español. Seville.
Bollettino Consolare. Rome.
Bolletino delle Scienze Mediche. Bologna.
Bologna: R. Deputazione di Storia Patria: Publications.
    Società Medica-Chirurgica: Publications.
Bone, Algeria: Académie d' Hippone: Publications.
Bookseller. London.
Boston Journal of Chemistry.
Boston: American Academy of Arts and Sciences: Memoirs, Proceedings.
    Mass. Historical Society: Publications.
    National Assoc. of Wool Manufacturers: Bulletin.
    New England Historico-Genealogical Society: Publications.
    Public Library: Bulletin.
    Society for Psychical Research: Publications.
    Society of Natural History: Publications.
    Webster Historical Society: Spectator.
    Zoölogical Society: Quarterly Journal.
Botanische Zeitung. Leipsic.
Bradstreet's. New York.
Brain. London.
Brescia: Ateneo di Brescia. Commentari.
British Assn. for the Advancement of Science: Publications. London.
British and Colonial Manufacturer. London.
British Medical Journal. London.
British Quarterly Review. London.
Brussels: R. Académie des Sciences de Belgique: Publications.
    Musée Royale d'Histoire Naturelle: Publications.
    Observatoire Royale: Publications.
Bulletin Astronomique. Paris.
Bulletin des Sciences Mathématiques et Astronomiques. Paris.
Bulletin Monumental. Paris.
Bulletin Trimestriel des Antiquites Africaines. Paris.
Bullettino di Archeologia Cristiana. Rome.
Bullettino di Bibliograph. e di Storia della Sci. Matemat. e Fisiche. Rome.
Bullettino Italiano degli Studii Orientali. Florence.
Bulletin of Mass. Natural History. Amherst.
Bulletin of the National Association of Wool Manufacturers. Boston.
Caen: Académie des Sciences, Arts et Belles-Lettres: Publications.
    Société des Pharmaciens du Calvados, etc.: Bulletin.
Calcutta: Asiatic Society of Bengal: Publications.
California Academy of Sciences: Publications. San Francisco.
Cambridge, (Eng.): Antiquarian Society: Publications.
    Philological Society: Publications.
    Philosophical Society: Proceedings: Transactions.
    University Reporter.
Cambridge, (Mass.): Harvard Coll. Observatory: Bulletin.
    Museum of Comparative Zoölogy: Bulletin.
    Harvard College Library: Bulletin.
Canada Geological and Nat. History Survey. Ottawa.
Canada, Royal Society: Publications.
Canadian Naturalist and Quarterly Journal of Science. Montreal.
Canadian Record of Nat. Hist. and Geology. Montreal.
Canadian Record of Science. Montreal.
Cassel: Verein f. Naturkunde: Bericht.
Catalogue Mensuel de la Librairie Française. Paris.
Centralblatt f. d. Medicinischen Wissenschaften. Berlin.
Centralblatt f. Electrotechnik: Munich and Leipsic.
Century Magazine. New York.
Charkow, Russia: Mathematical Society: Proceedings.
Chaucer Society: Publications. London.
Chemical News. London.
Chemiker-Zeitung. Cöthen.
Chemisches Centralblatt. Leipsic.
Cherbourg: Société Nation. d. Sciences Nat. et Math.: Publications.
Chicago: Academy of Sciences: Publications.
Christiania, (Norway): University: Publications.
    Commiss. der Gradmessung: Publications.
    Société des Sciences: Publications.
Christian Socialist. London.
Cincinnati: Mechanics' Institute: Transactions.
    Observatory: Publications.
    Public Library: Bulletin.
    Society of Natural History: Journal.
Civilingenieur. Dresden.
Colombo, Ceylon: Royal Asiatic Society, (Ceylon Branch): Publications.
Colorado Museum of Applied Geology and Mineralogy. Denver.
Como: Società Storica per la Provincia di Como: Periodico.
Concord: New Hampshire Historical Society: Publications.
Concordia. Mainz.
Connecticut Academy of Arts and Sciences: Publications. New Haven.
Constantinople: Hellenikos Philologikos Syllogos.
Contemporary Review. London.
Coöperative Index to Periodicals. New York.
Copenhagen: Royal Academy of Sciences: Memoirs: Bulletin.
Córdoba, (Arg. Rep.): Academia Nacional de Ciencias: Actas: Boletin.
Cornell University Library. Ithaca, N. Y.
Cosmos. Paris.
Critic. New York.

Cronica Cientifica. Barcelona.
Crystallogical Society: Proceedings. London.
Cultura (La). Rome.
Davenport (Iowa): Academy of Nat. Sciences: Publications.
Delft: Ecole Polytechnique: Annales.
Denver: Colorado Museum of Geology, etc.: Publications.
Scientific Society: Publications.
Deutsche Chemische Gesellschaft: Berichte. Berlin.
Deutsche Gemeinde-Zeitung. Berlin.
Deutsche Journal Katalog. Leipsic.
Deutsche Literaturzeitung. Berlin.
Deutsche Rundschau. Berlin.
Deutsche Shakspeare-Gesellschaft: Jahrbuch. Berlin.
Deutsche Zeit- und Streitfragen. Berlin.
Dingler's Polytechnisches Journal. Augsburg.
Dresden: Naturwissenschaftliche Gesellschaft Isis: Publications.
Dublin: Royal Dublin Society: Publications.
Royal Irish Academy: Publications.
University Press: Publications.
University Review.
Early English Text Society: Publications. London.
Eclectic Magazine. New York.
Economist. London.
Économiste (L') Français. Paris.
Edinburgh Review. Edinburgh.
Edinburgh: Royal Physical Society: Publications.
Royal Society: Publications.
Education. Boston.
Educational Times. London.
Electrical Review. New York.
Electrical World. New York.
Electrician. London.
Electrician and Electrical Engineer. New York.
Électricité (L'). Paris.
Engineering and Mining Journal. New York.
English Catalogue of Books. London.
English Dialect Society: Publications. London.
Englische Studien. Heilbronn.
Erlangen: Acta Seminarii Philologici.
Essex Institute: Historical Collections. Salem.
Expositor. Kelso, Scotland.
Fauna u. Flora d. Golfes v. Neapel. Naples.
Finanz-Archiv. Stuttgart.
Florence: Società Entomologica Italiana. Atti.
Folk-Lore Journal. London.
Foreign Church Chronicle. London.
Forestry Bulletin. New York.
Fortnightly Review. London.
Fortschritte der Physik. Berlin.
Franco-Gallia: Wolfenbüttel.
Frankfort a. M.: Senckenbergische Naturforschende Gesellschaft: Berichte.
Frankfort a. O: Naturwissenschaft. Verein. Mittheilungen.
Franklin Institute: Journal. Philadelphia.
Freiburg i. B: Naturforschende Gesellschaft: Publications.
Gazetta Chimica Italiana. Palermo.
Gazette Archéologique. Paris.
Gazette Médicale de Paris. Paris.
Gegenwart (Die). Berlin.
Genoa: Società di Letture: Giornale.
Geological Magazine. London.
Geological Society: Quarterly Journal. London.
Geologiska Foreningens, etc. Stockholm.
Georgia Historical Society: Publications. Savannah.
Germania. Vienna.
Giornale di Filologia Romanza. Rome.
Giornale di Matematiche. Naples.
Giornale Ligustico di Archeologia, Storia, etc. Genoa.
Glasgow: Philosophical Society: Proceedings.
Observatory of University: Publications.
Göttingen: König. Gesellsch. d. Wissenschaften: Publications.
Göttingische Gelehrte Anzeigen. Göttingen.
Göttingische Gelehrte Nachrichten. Göttingen.
Graefe's Archiv f. Ophthalmologie. Berlin.
Graphischen Künste. Vienna.
Granite Monthly. Concord, N. H.
Guy's Hospital Reports. London.
Halifax, (Nova Scotia): Institute of Natural Science: Bulletin.
Hamburg: Naturhistorisches Museum: Publications.
Wissen. Anstalten: Jahrbuch.
Hanover: Historische Verein f. Niedersachsen: Zeitschrift.
Harlem: Musée Teyler: Publications.
Société Hollandaise des Sciences: Archives.
Harper's Magazine. New York.
Harvard University Bulletin. Cambridge.
Hebraica. Morgan Park, Ill.
Heidelberg: Naturhistor.-Medicinische Verein: Publications.
Helsingfors: Societa Scientiarum Fennica: Publications.
Hermannstadt: Verein für Naturwissenschaften: Publications.
Hermes. Berlin.
Historisches Jahrbuch der Görres-Gesellschaft. Munich.
Historische Zeitschrift (Sybel). Munich.
Illinois State Laboratory of Natural History: Bulletin.
Index Medicus. Detroit.
Indian Antiquary. Bombay, India.
Industrial America. New York.
Industrial Review. Philadelphia.
International. Zeitsch. f. Allgem. Sprachwissensch. Leipsic.
Investor's Manual. London.
Iowa Historical Record. Iowa City.
Iowa State Historical Society: Publications. Iowa City.
Iron Age. New York.
Jahrbuch d. Gesellsch. f. Bildende Künste. Vienna.
Jahrbuch d. Hamburgischen Wis. Anstalten. Hamburg.
Jahrbuch f. Gesetzgebung, etc. Leipsic.
Jahrbuch üb. d. Fortschritte der Mathematik. Berlin.
Jahrbücher f. Classische Philologie. Leipsic.
Jahrbücher f. Nationalökonomie, u. Statistik. Jena.
Jahrbücher f. Roman. u. Engl. Literatur. Leipsic.
Jahrbücher f. Wissenschaftliche Botanik. Leipsic.
Jahresbericht d. Geschichtswissenschaft. Berlin.
Jahresbericht f. Reine Chemie. Tübingen.
Jahresbericht üb. d. Chemie u. Physik. Giessen.
Jahresbericht üb. d. Erschein a. d. Gebiete d. German Philologie. Berlin.
Jahresbericht üb. d. Fortsch. d. Anat. und Physiol. (Hoffmann). Leipsic.
Jahresbericht üb. d. Fortschritte d. Chemie. Marburg.
Jahresbericht üb. d. Fortsch. d. Class. Alterthumswiss. (Bursian). Berlin.
Jahresbericht üb. d. Leistungen der Chemisch. Technologie. Leipsic.
Jahresbericht üb. d. Leistungen u. Fortsch. der Medicin. Berlin.
Jahresbericht üb. d. Leist., in d. Anat. u. Physiol. (Virchow). Berlin.
Jenaische Zeitschrift für Naturwissenschaft. Jena.
Jornal de Sciencias Mathematicas e. Astronomicas. Coimbra.
Journal Asiatique. Paris.
Journal de l'Anatomie. Paris.
Journal de l'École Polytechnique. Paris.
Journal de Mathématiques Pures et Appliquées. Paris.
Journal de Physique Théorique et Appliquée. Paris.
Journal des Économistes. Paris.
Journal des Sociétés Scientifiques. Paris.
Journal für Praktische Chemie. Leipsic.
Journal für Reine u. Angewandte Mathematik (Crelle). Berlin.
Journal of Anatomy and Physiology. London.
Journal of Christian Philosophy. New York.
Journal of Comparative Medicine and Surgery. New York.
Journal of Conchology. London.
Journal of Education. Boston.
Journal of Education. London.
Journal of Hellenic Studies. London.
Journal of Mental Science. London.
Journal of Microscopy and Natural Science. Bath, Eng.
Journal of Military Service Institution. Governor's Island, N. Y.

Journal of Mycology. Manhattan, Kansas.
Journal of Nervous and Mental Diseases. New York.
Journal of Philology. London.
Journal of Physiology. London.
Journal of Speculative Philosophy. New York.
Journal of the Assoc. of Engineering Societies. New York.
Kansas State Historical Society. Topeka.
Kiel: University: Publications.
Astronomische Nachrichten.
Kosmos. Stuttgart.
Lancet. London.
Landwirthschaftliche Versuchsstationen. Berlin.
Law Quarterly Review. London.
Leipsic: Astronomische Gesellschaft: Vierteljahrsschrift.
K. Sächsische Gesellsch. d. Wissenschaften: Publications.
Leyden: Dierkundige Verein. Publications.
Library Journal. New York.
Liebig's Annalen der Chemie (Wöhler, Kopp). Leipsic.
Liège: Société Royale des Sciences: Memoires.
Linnean Society of New South Wales: Publications. Sydney.
Linnean Society of N. Y.: Publications. New York.
Lisbon: Academia Real das Sciencias: Publications.
Sociedade da Geografia: Boletino.
Literarisches Centralblatt. Leipsic.
Literary News. New York.
Literary World. Boston.
Literaturblatt. f. Germ. u. Rom. Philologie. Heilbronn.
Literaturblatt. f. Orientalische Philologie. Leipsic.
London, Edinburgh and Dublin Philosophical Magazine.
London Quarterly Review.
London: Ballad Society: Publications.
British Assoc'n for the Advanc't of Science: Publications.
Chaucer Society: Publications.
Chemical Society: Journal.
Conchological Society: Proceedings (Jour. of Conchology).
Crystallogical Society: Proceedings.
Early English Text Society: Publications.
English Dialect Society: Publications.
Folk Lore Society: Publications.
Geological Society: Quarterly Journal.
Guy's Hospital: Reports.
Index Society: Publications.
Institute of Actuaries: Journal.
Mathematical Society: Proceedings.
Mineralogical Society of Great Britain and Ireland: Transactions.
New Snakspere Society: Publications.
Palaeographical Society: Publications.
Palestine Exploration Fund: Statements.
Pali Text Society: Publications.
Philological Society: Transactions.
Royal Astronomical Society: Memoirs and Proceedings.
Royal Institution: Publications.
Royal Microscopical Society: Proceedings.
Royal Society: Philos. Transactions: Proceedings.
Science and Art Department, South Kensington: Publications.
Society for Psychical Research: Proceedings.
Society of Biblical Archæology: Publications.
Society of Chemical Industry: Journal.
Society of Telegraph Engineers: Journal.
Statistical Society: Journal.
Spenser Society: Publications.
Lowell, Mass.: Historical Association: Publications.
Lumière Électrique (La). Paris.
Macmillan's Magazine. London.
Madison, (Wis.): Washburn Observatory: Publications.
Wisconsin Historical Society: Proceedings.
Madrid: R. Academia de la Historia: Publications.
Observatorio Astronomico: Publications.
Magazin f. d. Litteratur d. In u. Auslandes. Leipsic.
Magazine of American History. New York.
Magazine of Western History. Cleveland.
Maine Historical and Genealogical Recorder. Portland.
Maine Historical Society: Collections. Portland.
Mainz: Mittelrheinische Fabrikanten Verein: Mittheilungen.
Manchester: Literary and Philosophical Society: Publications.
Manufacturer and Builder. New York.
Manufacturer. London.
Maryland Historical Society: Publications. Baltimore.
Maryland Medical Journal. Baltimore.
Massachusetts Magazine. Boston.
Mathematische Annalen (Clebsch). Leipsic.
Mathematical Magazine. Erie, Pa.
Mathematical Visitor. Erie, Pa.
Mathesis. Ghent.
Medical and Chirurgical Faculty of Maryland: Transactions.
Medical Literature. New York.
Medical News. Philadelphia.
Medical Register. Philadelphia.
Medical Times and Gazette. London.
Medico-Legal Journal. New York.
Messenger of Mathematics. London.
Mexico: Observatorio del Mexico: Boletino.
Milan: Istituto Lombardo di Scienze e Lettere: Rendiconti.
R. Accademia di Belle Arti: Publications.
Mind. London.
Mineralogical Magazine. London.
Mineralogical Society of Great Britain and Ireland: Publications. London.
Mineralogische u. Petrograph. Mittheilungen. Vienna.
Minneapolis: Minnesota Acad. of Nat. Science: Publications.
Minnesota Historical Society: Collections. St. Paul.
Minnesota Nat. Hist. and Geological Survey: Publications.
Missionary Review. Princeton, N. J.
Mittheil. a. d. Medicinische Klinik. Würzburg.
Mnemosyne. Leyden.
Monatshefte für Chemie. Vienna.
Monatsschrift f. Geschichte u. Wissenschaft des Judenthums. Krotoschin.
Moniteur Scientifique Quesneville. Paris.
Month. London.
Montreal: Royal Society of Canada: Transactions.
Natural History Society: Publications.
Morphologisches Jahrbuch. Leipsic.
Moscow: Société Impériale des Naturalistes: Bulletin.
Muktataf. Cairo, Egypt.
Munich: Kön. Bayer. Akad. der Wissenschaften: Publications.
Görres-Gesellschaft: Jahrbuch.
Muséon (Le). Louvain.
Museum of Comparative Zoölogy: Publications. Cambridge, Mass.
Naples: R. Academia delle Scienze Fisiche e. Mathematiche: Publications.
Società di Storia Patria: Publications.
Zoölogical Station: Publications.
Nation. Berlin.
Nation. New York.
National Academy of Sciences: Publications. Washington.
National Review. London.
Nature. London.
Naturforscher (Der). Berlin.
Nautical Almanac. London.
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